Evolution of Argentine Electricity Sector

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Abstract

This paper addresses the changes that took place due to the restructuring of the energy industry in República Argentina in general terms and looking at the generation industry in particular. The paper also describes the Institutions that have important roles in the Wholesale Electricity Market (WEM), and briefly their principal activities, including the regulatory authority and the company that carries out the operation and administration of the WEM.

The transformation of the Argentinean Electricity Market is then described, some of the highlights of the privatization process pointed out, as well as organizational aspects of the WEM, market integration and Mercosur.

The transmission system plays a role taking into account its capacity to transmit energy that is bought or sold among the agents, so a description of the basic outline of transmission regulation is made.

Some typical figures about WEM members or agents are then shown, like the number of agents by activity and the way it was changing over the time.

Generation in the WEM is then analyzed, showing the types of generation in Argentina, composition of total generation, annual evolution of generation by type, installed capacity, thermal and hydraulic generation, and some other figures that are intended to give an overview of how the electrical parameters related to generation have evolved within the new market rules.

The evolution of thermal availability is then shown, and so are other figures that give a chance to see how the new technologies and the competitive generation market influenced the overall efficiency of the generation industry. References are made to other closely related subjects, like natural gas, reserves, and pipelines in South America.

Also shown are slides that give energy and economical prices and their evolution through time, as well as spot and term market prices, and their relationships, from which the influence of the new market rules, particularly on the generation industry, can be dramatically seen, as compared with those prices belonging to early stages of the development.

Finally, some comments are made about the necessity to cope with the new challenges in order to improve the already very good functioning of the WEM, and also about the power sector present and future main activities.

EVOLUTION OF ARGENTINE ELECTRICITY SECTOR

Ing Ramón SANZ
Adviser of Secretariat and Vicepresident of CAMMESA as representative of Secretariat
October1997

ENERGY AND PORT SECRETARIAT
MINISTRY FOR ECONOMY AND PUBLIC WORKS AND SERVICES

INSTITUTIONS AT WORK

ENERGY SECRETARIAT

- **DETERMINES SECTOR POLICIES.**
- **CREATES RULES AND REGULATION.**
- **MEDIATES AND RULES IN DISAGREEMENTS WITH NATIONAL ELECTRICITY REGULATORY COMMISSION RESOLUTIONS.**

INSTITUTIONS AT WORK

ELECTRICITY NATIONAL REGULATORY COMMISSION

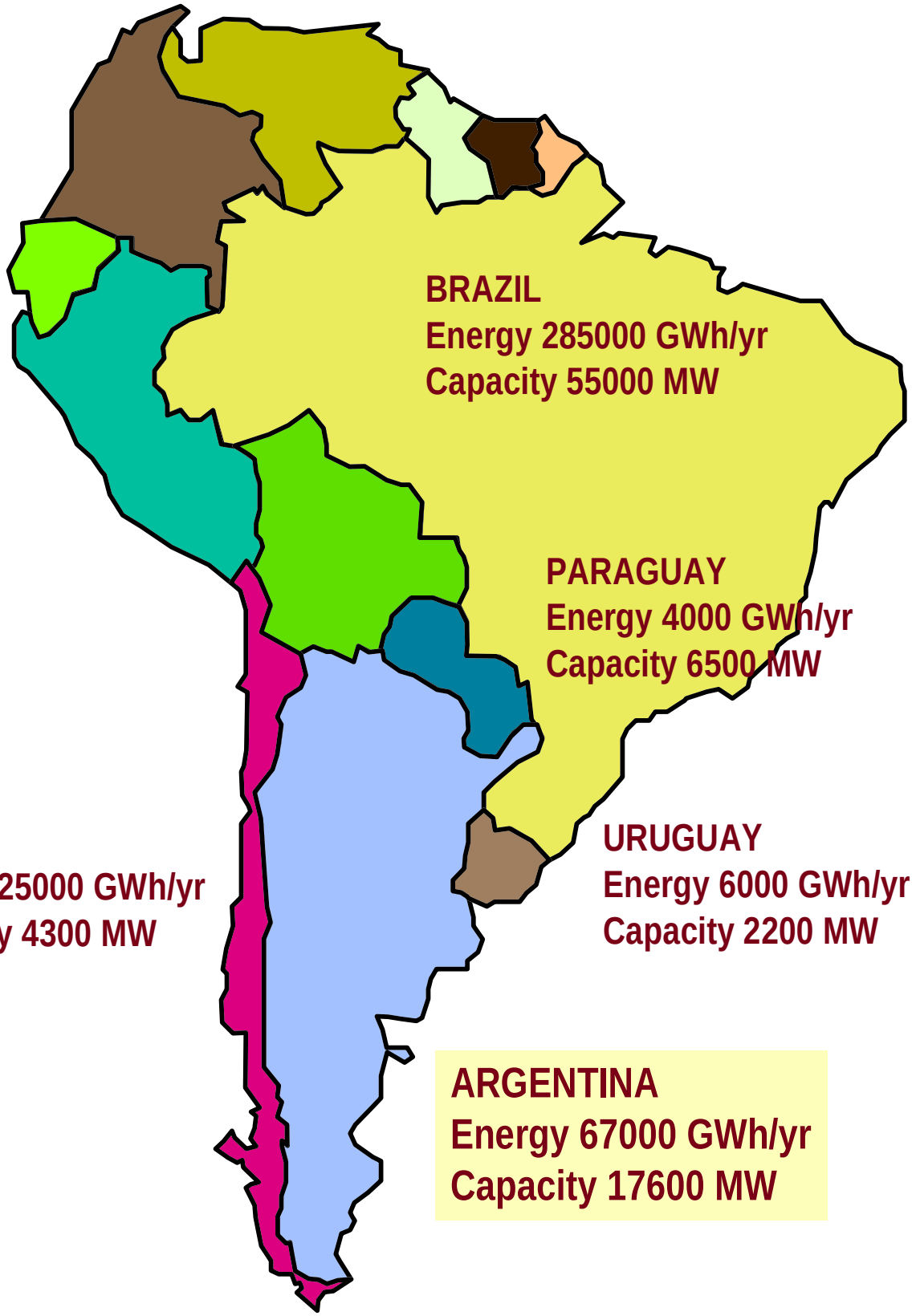
- **SUPERVISE COMPLIANCE WITH LEGAL FRAMEWORK OF PRIVATE OPERATORS.**
- **ORGANIZES & APPLIES PUBLIC PARTICIPATION.**
- **AUTHORIZES TARIFF MODIFICATION.**
- **SUPERVISE PUNISHMENT IN CASE OF LAW INCOMPLIANCE.**

INSTITUTIONS AT WORK

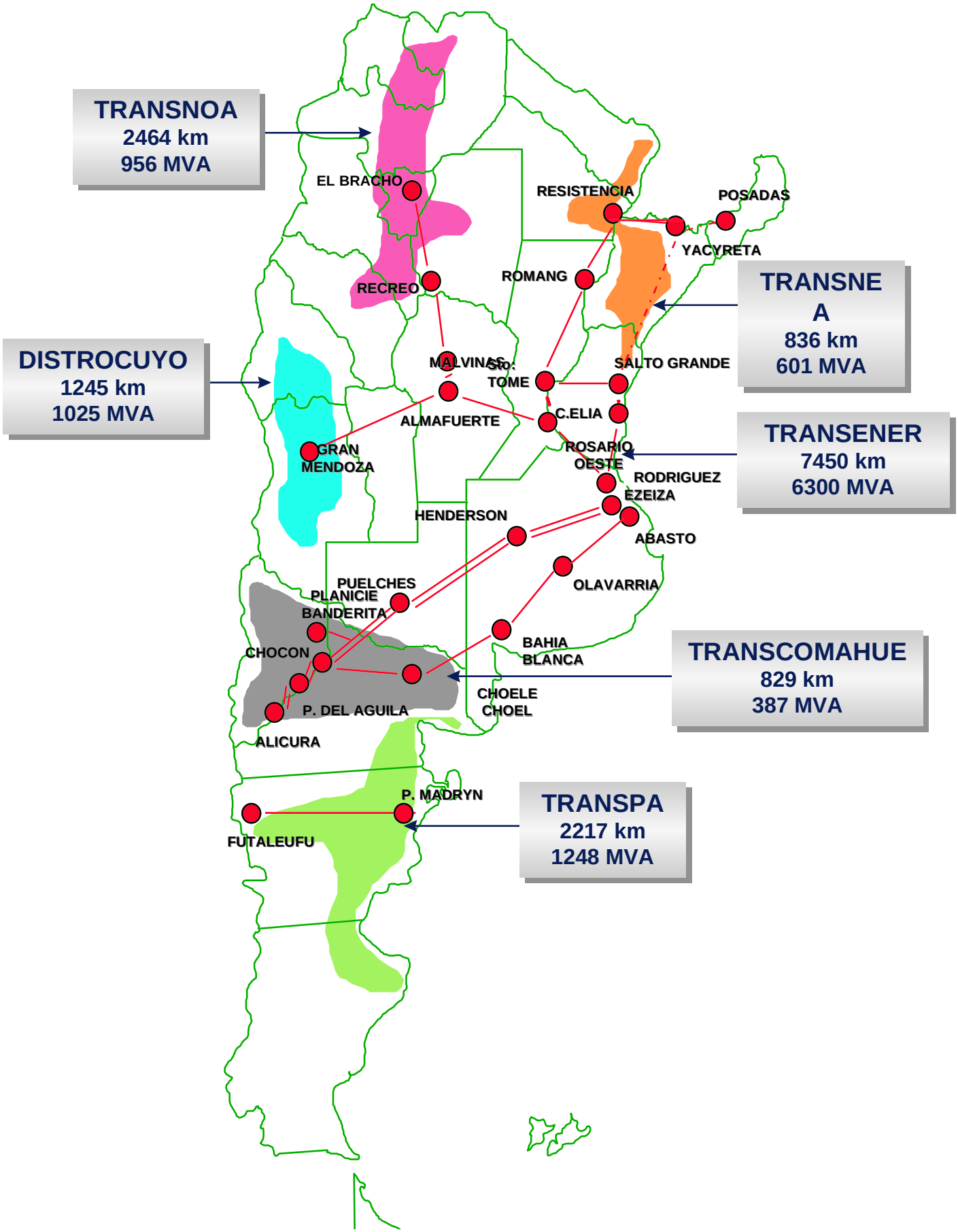
WHOLESALE ELECTRICITY MARKET ADMINISTRATION COMPANY (CAMMESA)

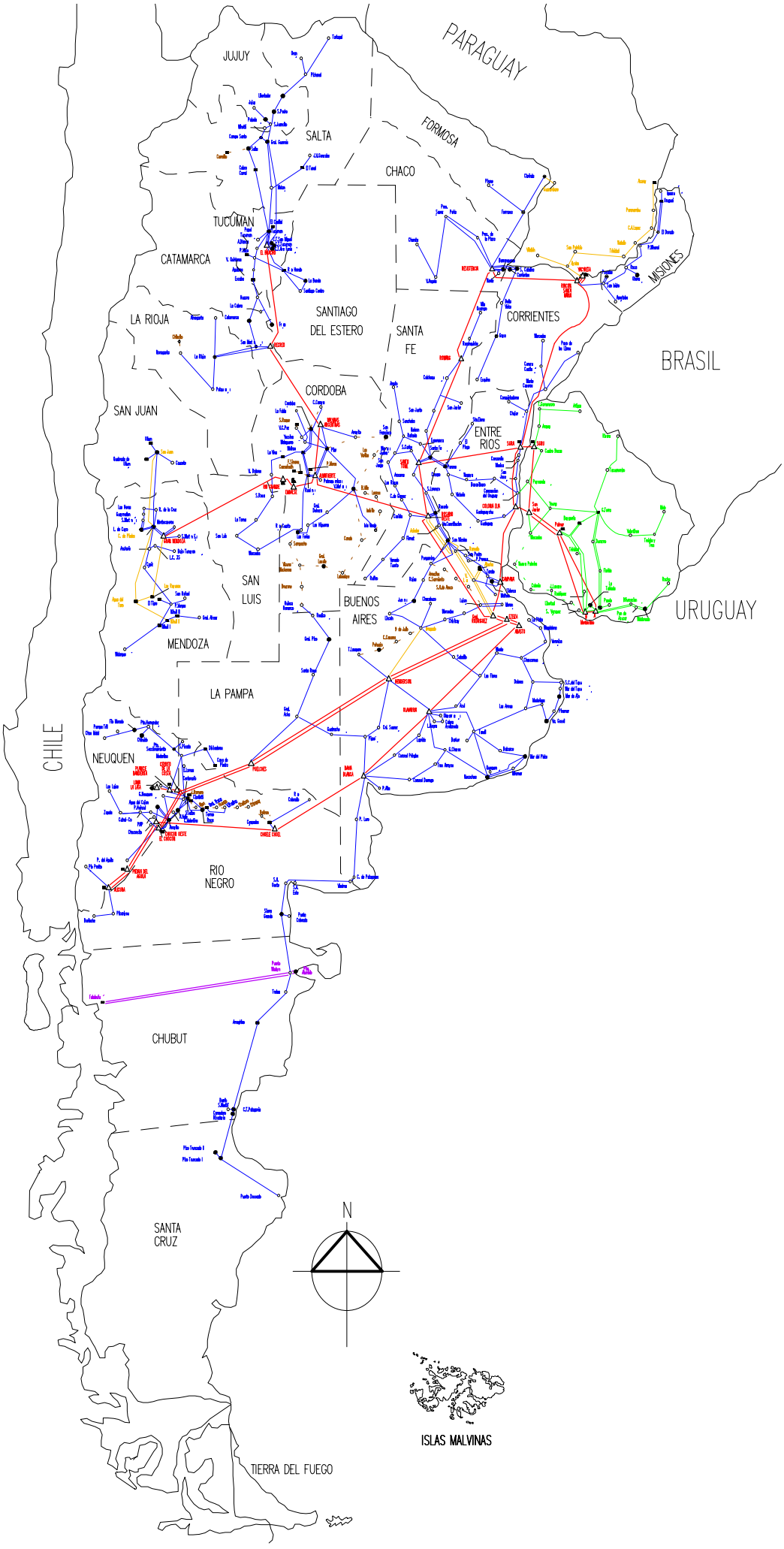
- **CAMMESA IS A NON PROFIT PARTNER-SHIP THAT:**
  - **OPERATES ELECTRIC SYSTEM IN REAL TIME.**
  - **CARRIES OUT GENERATION SUPPLY DISPATCH.**
  - **MANAGES COMMERCIAL ACTIVITIES AMONG ITS AGENTS.**

Electricity in the MERCOSUR

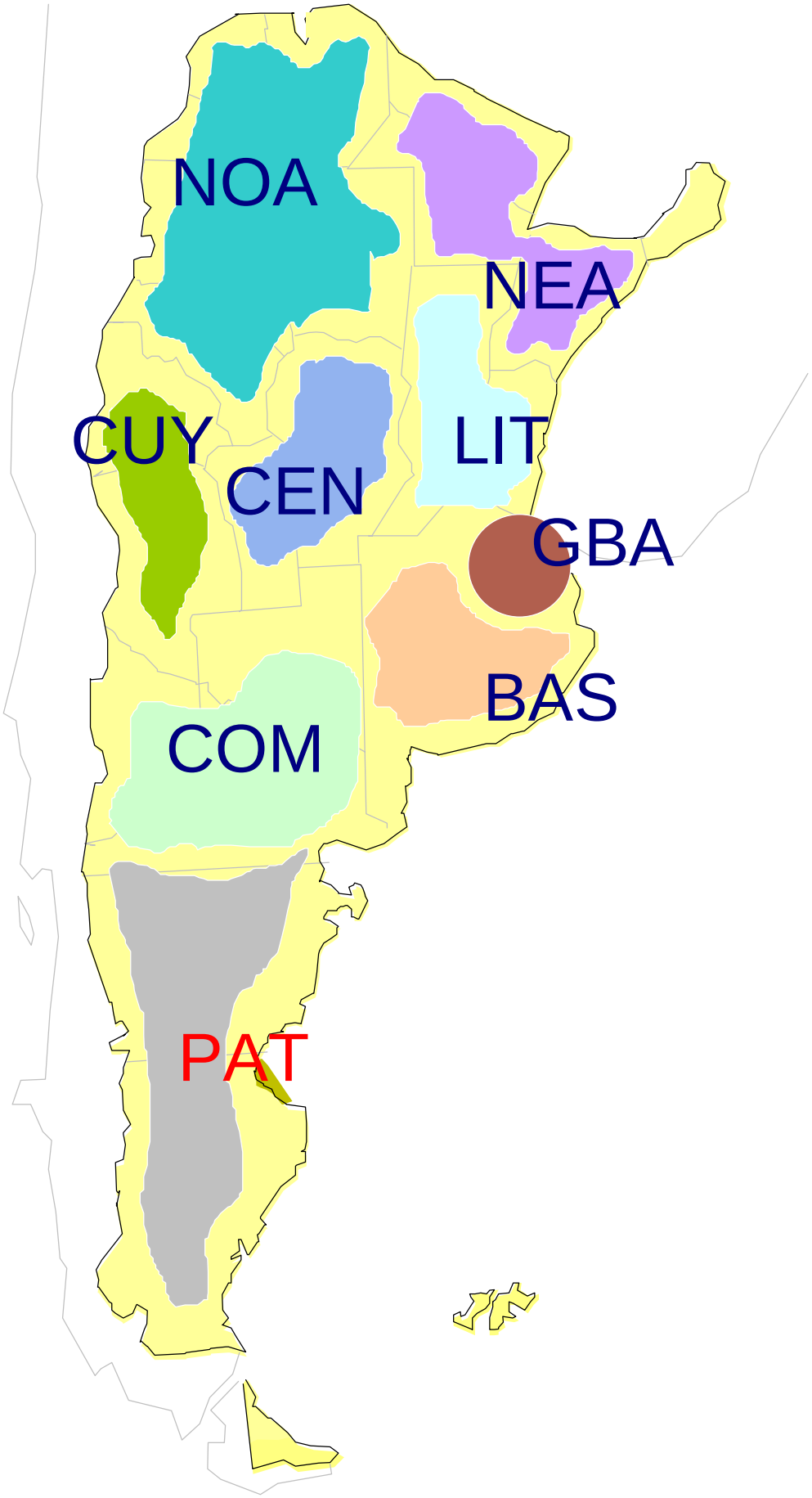


Argentine Interconnected System (SADI)




JUJUY
PARAGUAY
SALTA
FORMOSA
CHACO
TUCUMAN
CATAMARCA
MISIONES
LA RIOJA
SANTIAGO DEL ESTERO
SANTA FE
CORRIENTES
BRASIL
CORDOBA
SAN JUAN
ENTRE RIOS
SAN LUIS
BUENOS AIRES
URUGUAY
MENDOZA
LA PAMPA
CHILE
NEUQUEN
RIO NEGRO
CHUBUT
SANTA CRUZ
N
ISLAS MALVINAS
TIERRA DEL FUEGO

ARGENTINE ELECTRIC ZONES

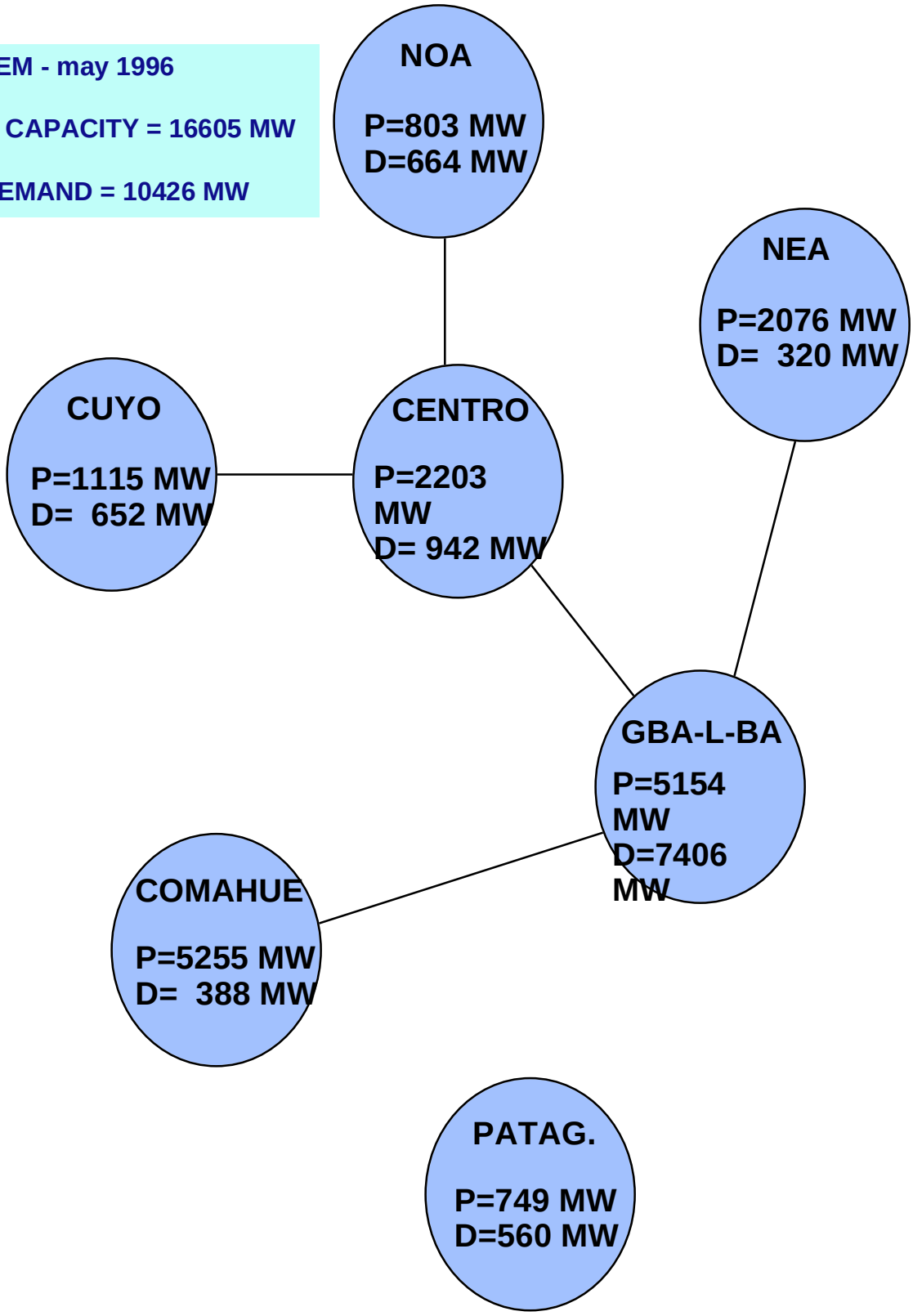


Installed Capacity And Peak Demand Per Zone

MEM - may 1996

INSTALLED CAPACITY = 16605 MW

PEAK DEMAND = 10426 MW



The Transformation of the Argentine Electrical Market

GOAL :

- set up the basis for a solid electrical industry capable of ensuring, both the economy and society, enough energy at the best price and reflecting the economic costs of maintaining and expanding the activity.

MEANS :

- clear division between the following activities:
  - those which may remain subject to market pressures
  - those which require regulation
- market prices system for risk activities (generation)
- concession agreements for activities requiring regulation (distribution, block transmission, hydroelectric generation)
- privatisation within the described framework
- creation of the entities required by model:
  - for the administration of the market (CAMMESA)
  - for the regulation of its activities (ENRE)

Highlights of Privatisation Process

- Encourage presence of several different suppliers in the Wholesale Energy Market (W.E.M..).
- Tariff based on economic costs.
- Enterprises value based on discounted cash flow.
- Capital expenditures are voluntary.
- Monopolistic companies will not be subjected to cost controls.
- Auditing system based on service quality and reliability.
- Support from external consultants.

Organizational Keys in the Argentine MEM

SIGNALS FOR EFFICIENCY

1.-the price of energy is determined by the market.

- this produces hourly prices based on the short term marginal cost for supplying demand.

2.- the market is a geographically located point

- purchases or sales of energy are made at “node prices” based on market prices and the distance and quality of the link between purchase/sale point and the market.

3.- differences in amount of energy between the different purchase/sale points and the market create revenues for transmission.

4.- other services that are necessary to ensure the technical operability of the electrical system are also remunerated.

Basic Outline of Transmission Regulation

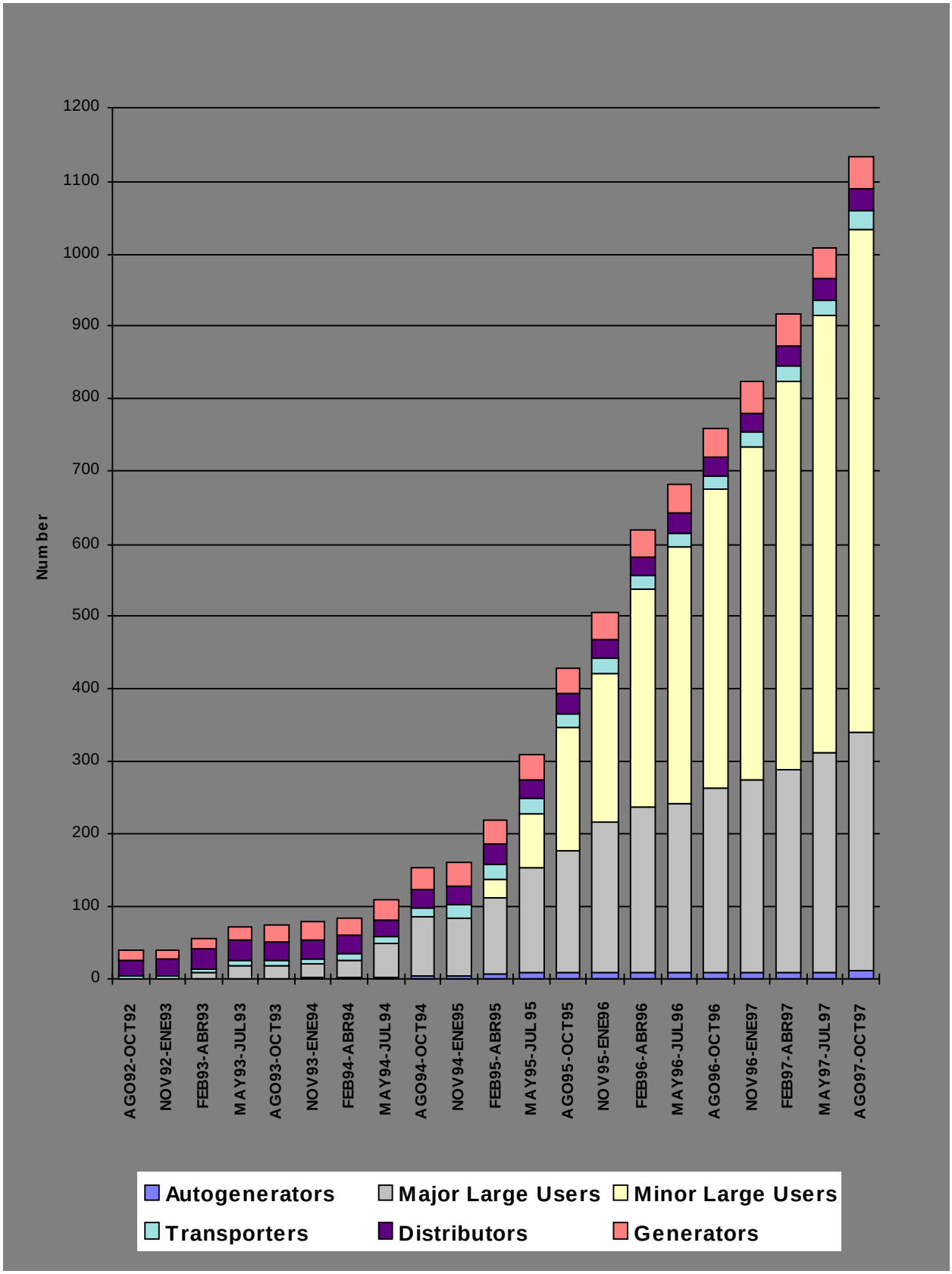
- free access of “active” agents of the market
- prohibition for carriers to compete with MEM agents; carriers cannot purchase nor sell electricity
- equal risk assumption associated with decision regarding future investments
- term of the concession contract: 95 years; may be extended for 10 additional years.
- management periods : rebidding of the controlling shareholder’s package (15 years for the first period and 10 years every period thereafter)
- 5 year tariff periods: recalculation of remuneration agreements

Provisions for Market Integration

In the end, the model contains the necessary elements to enable a progressive integration of the electrical market in the south cone of South America, on the basis of:

- Products appraisal on the basis of shared criteria of economic costs;
- Open borders for the participation of foreign agents in the national market;
- Reciprocity.

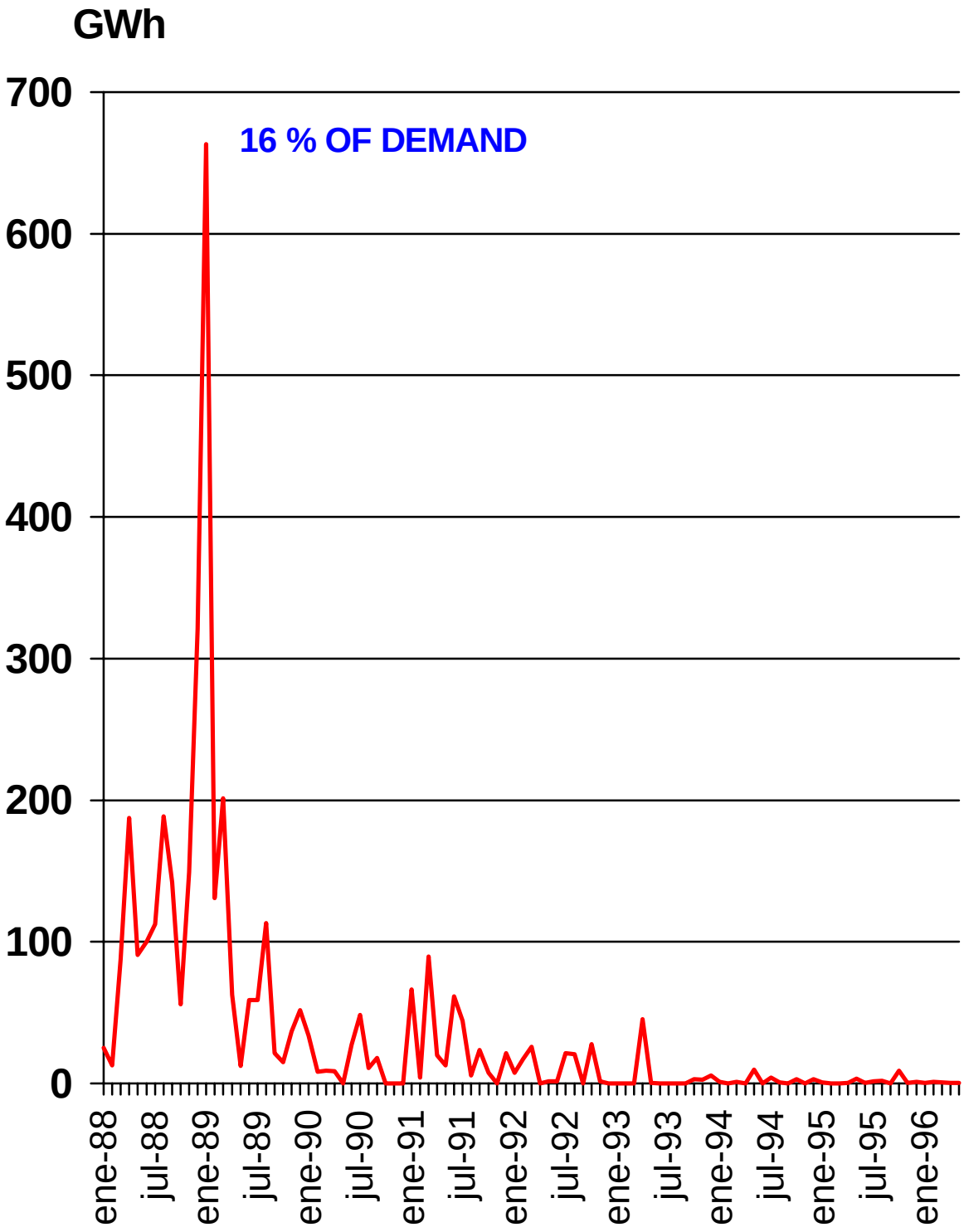
Number of MEM Members by Activity



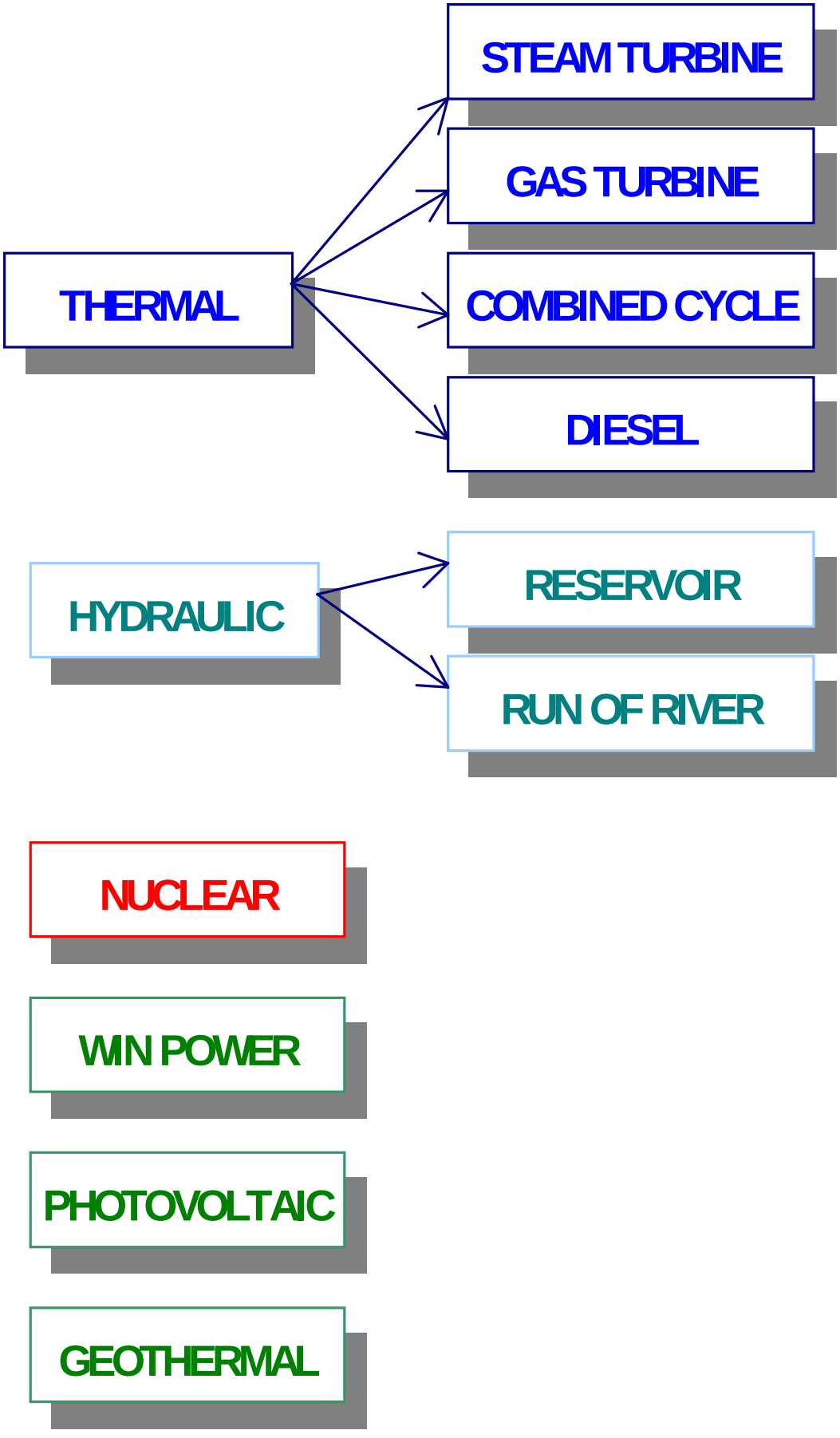
GENERATION

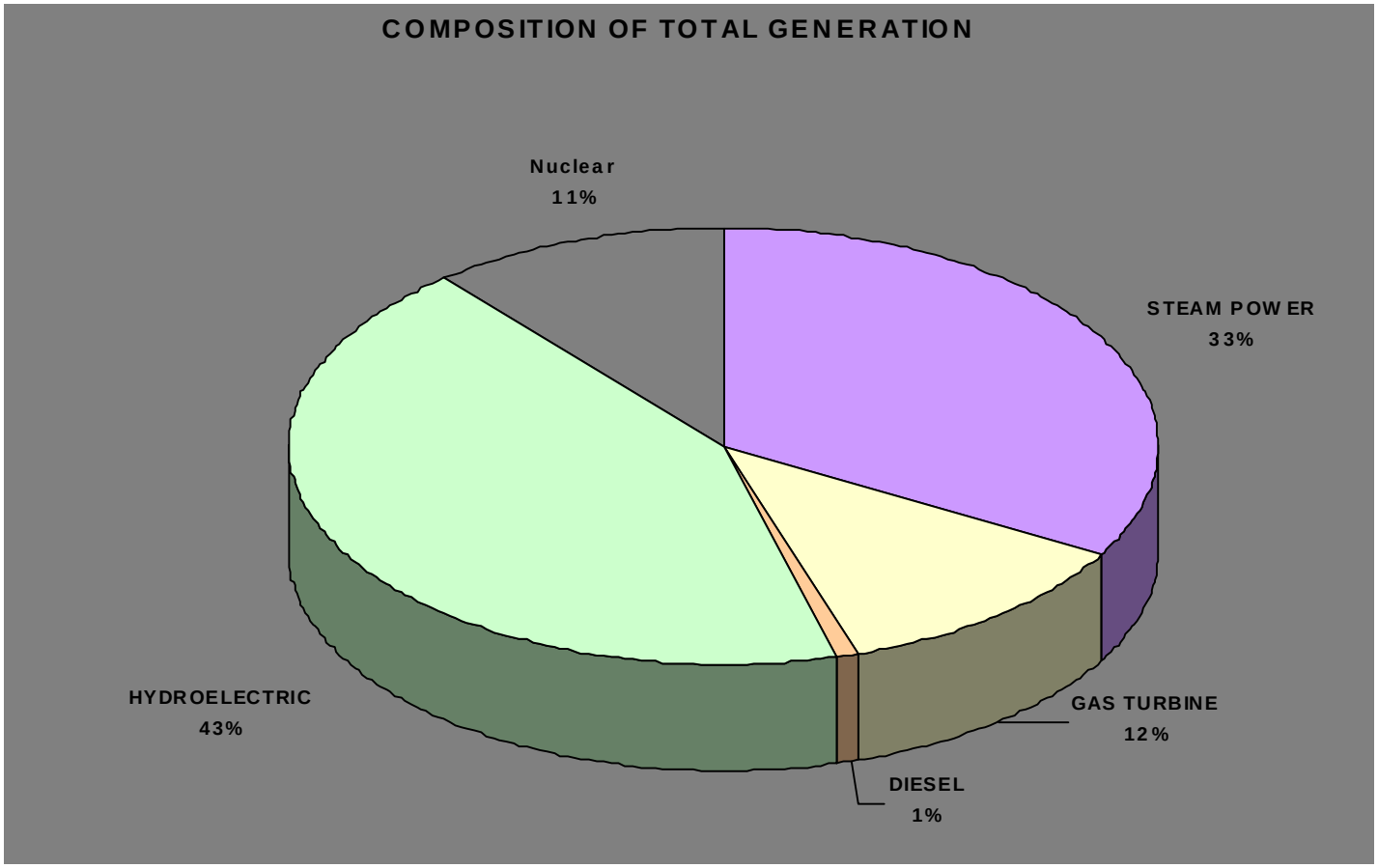
- Maximum availability in the existent generation
- A competitive market, also in local areas
- Open cycle and combine cycle gas turbines
- New units in the load center and remote nodes
- High influence from the gas sector
- Efficient fuel purchase
- Decreasing prices related with more increment of capacity than load
- Increase of production efficiency

Non Served Energy
Jan 88 - May 96



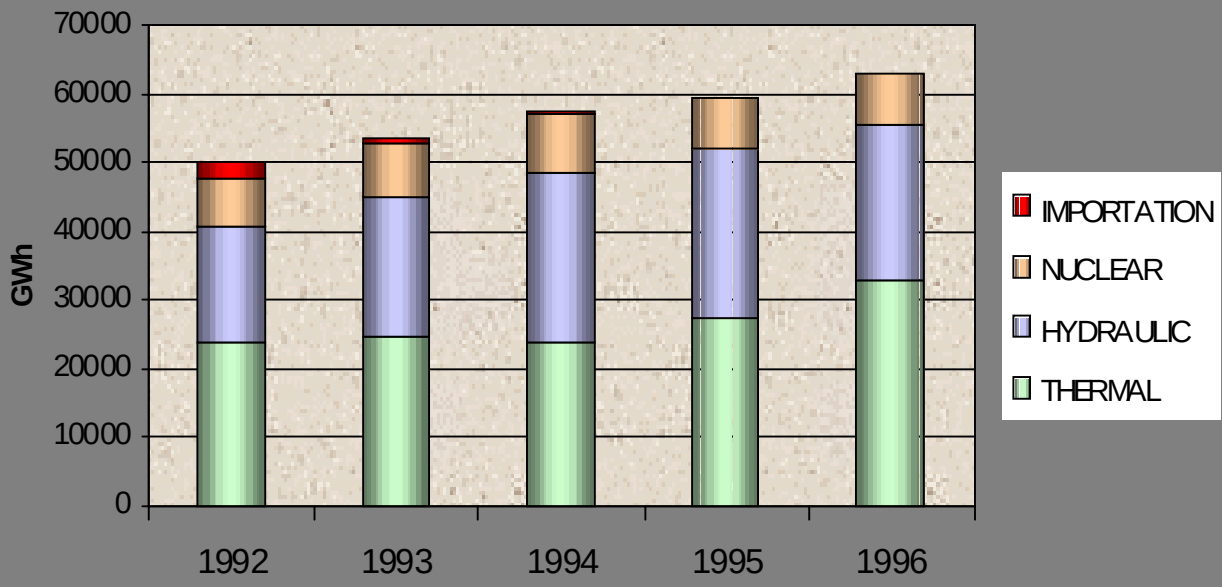
GENERATION TYPES EXISTING IN ARGENTINA



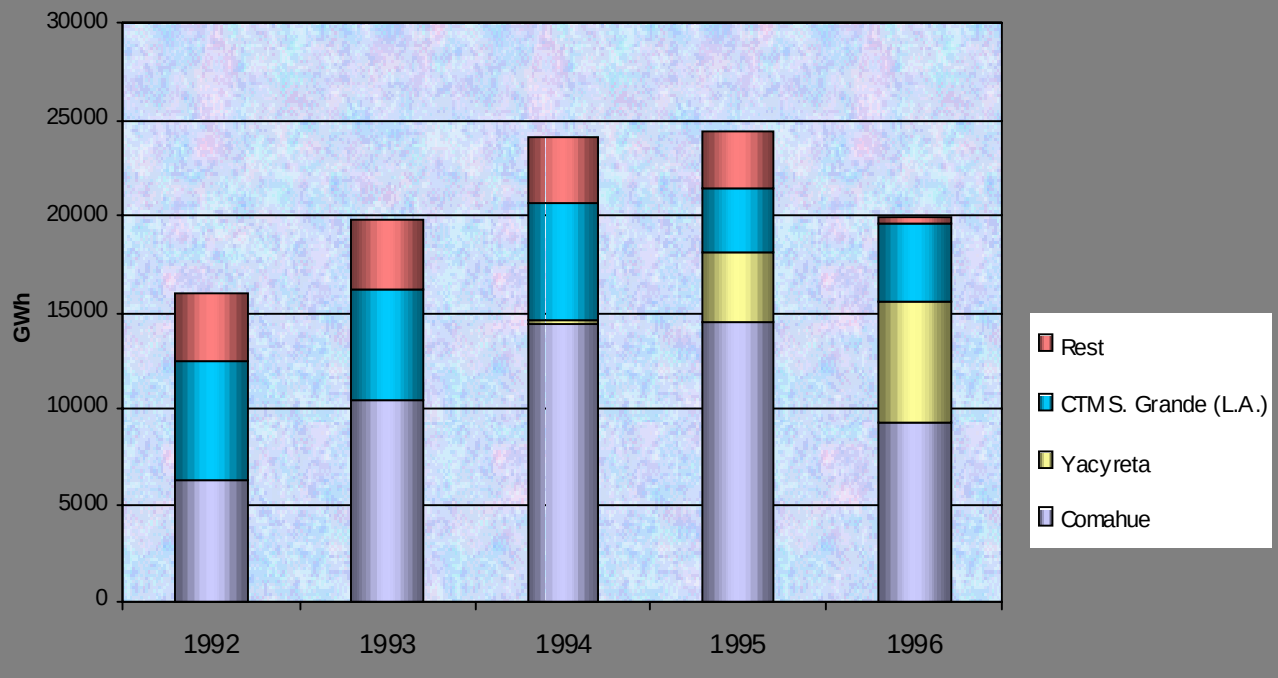


GENERATED ENERGY IN 1995 – GWh		
Steam turbine	20980	33.4%
Gas turbine	7347	11.7%
Diesel	500	0.8%
Total Thermal	28827	45.9%
Hydroelectric	26916	42.9%
Nuclear	7066	11.2%
Total	62809	100%

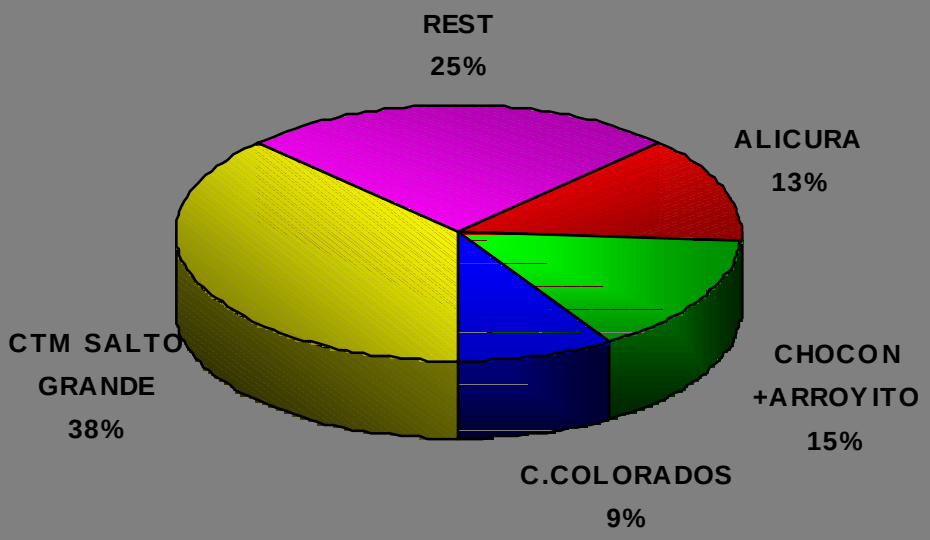
ANNUAL EVOLUTION OF GENERATION BY TYPE



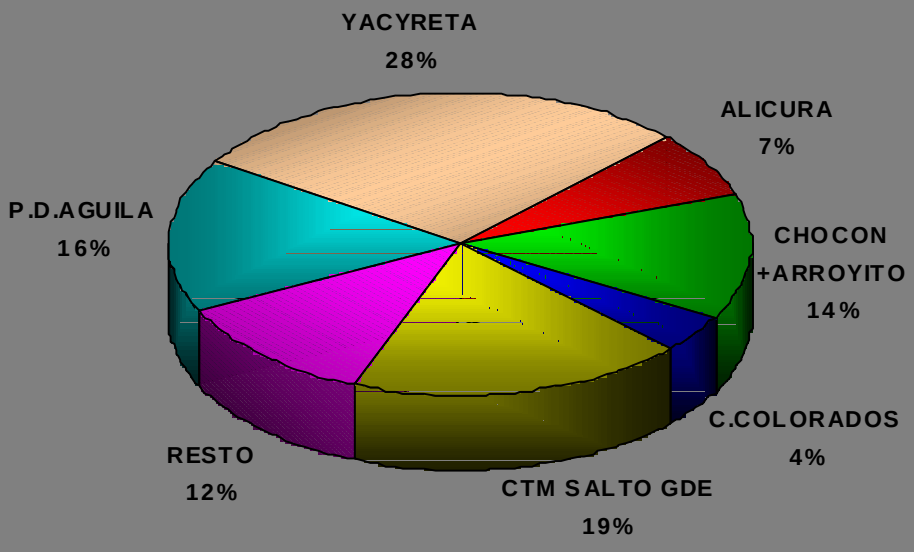
EVOLUTION OF HYDRAULIC GENERATION BY BASIN



PARTICIPATION IN THE HYDRAULIC GENERATION ANNUAL PER POWER PLANT - 1992

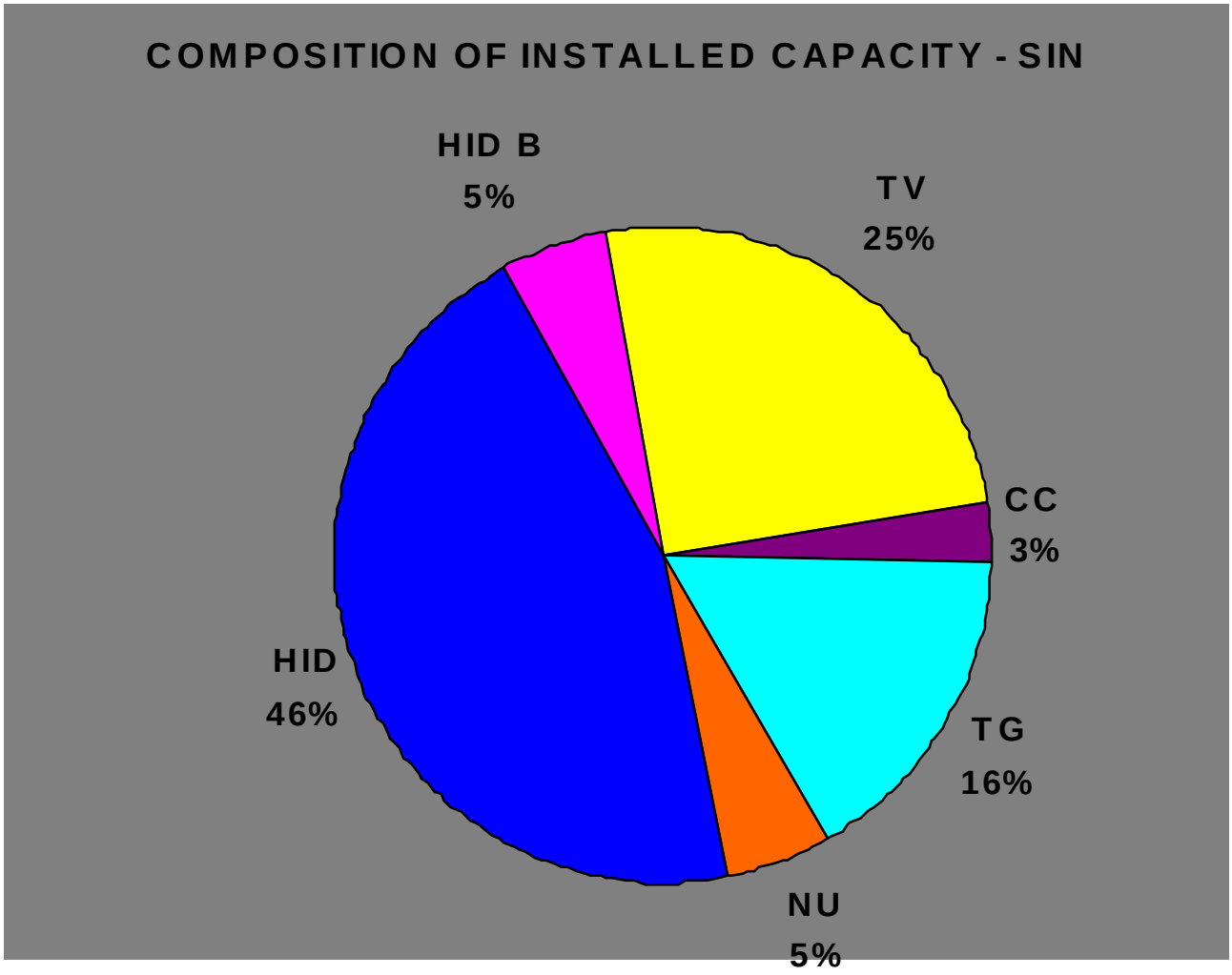


PARTICIPATION IN THE HYDRAULIC GENERATION ANNUAL PER POWER PLANT - 1996

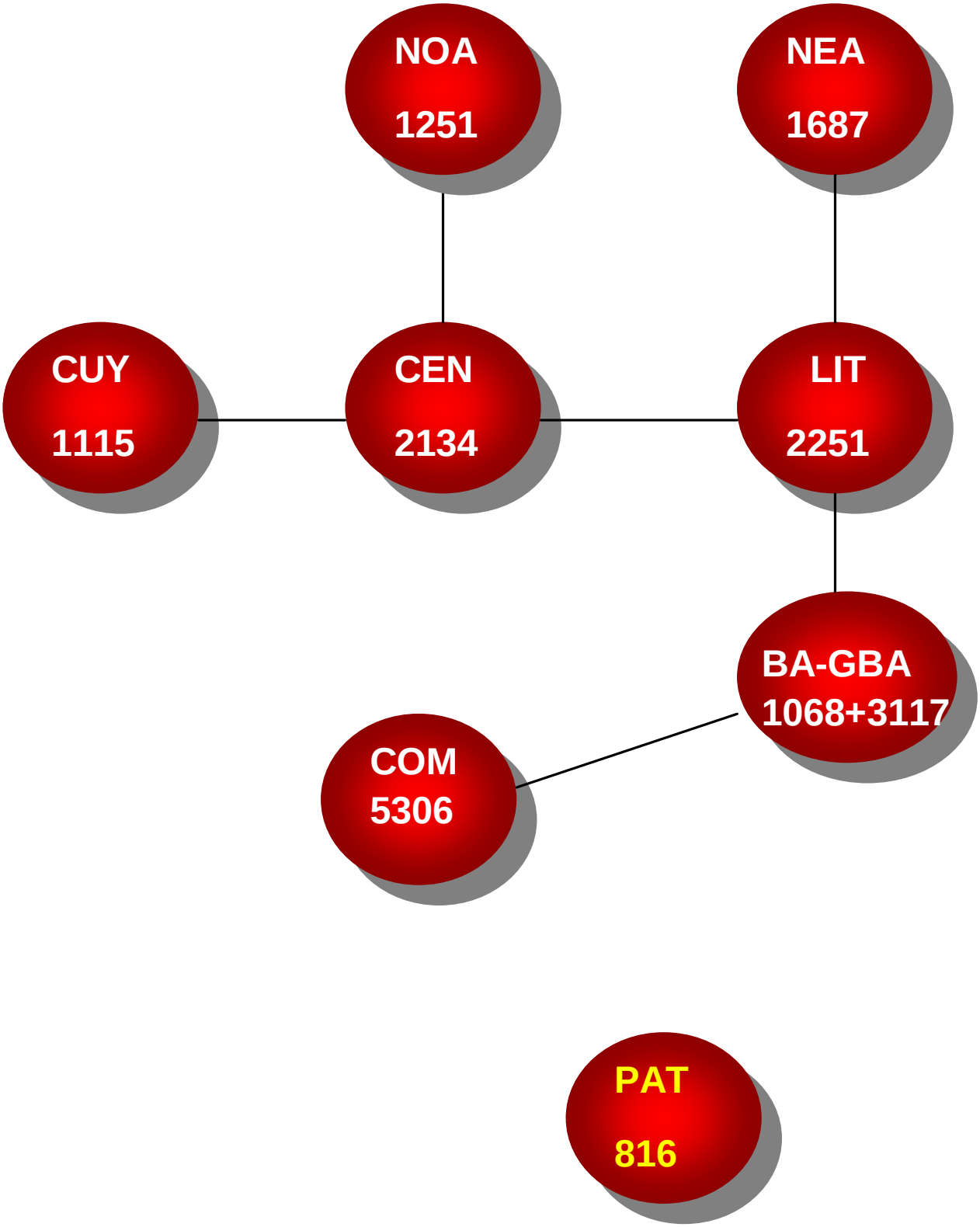


INSTALLED CAPACITY PER POWER PLANT (SIN)
PATAGONIC SYSTEM August 1997

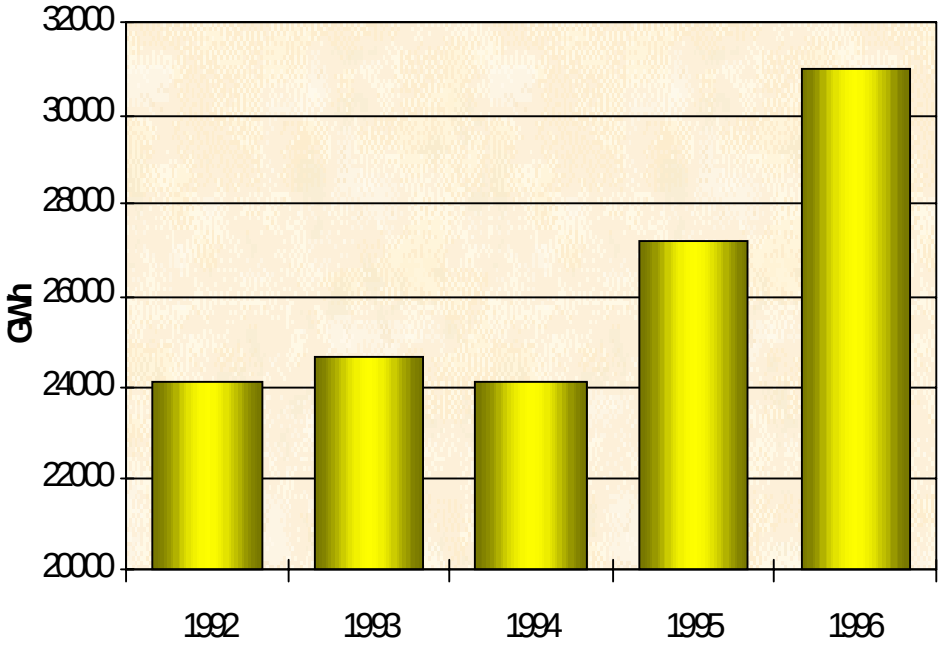
Región	TV	TG	CC	DI	TER	NU	HID	HID B	TOTAL
CUY	245	94	84		423		468	224	1115
COM		936	80		1016		4290		5306
NOA	340	738		4	1082		169		1251
CEN	227	287	60		574	648	162	750	2134
LIT	892	57			949	357	945		2251
GBA	2148	647	322		3117				3117
BAS	880	188			1068				1068
NEA	25	142			167		1520		1687
TOTSIN	4757	3089	546	4	8396	1005	8528	974	17929
PAT		322			322		494		816



INSTALLED CAPACITY PER ZONE

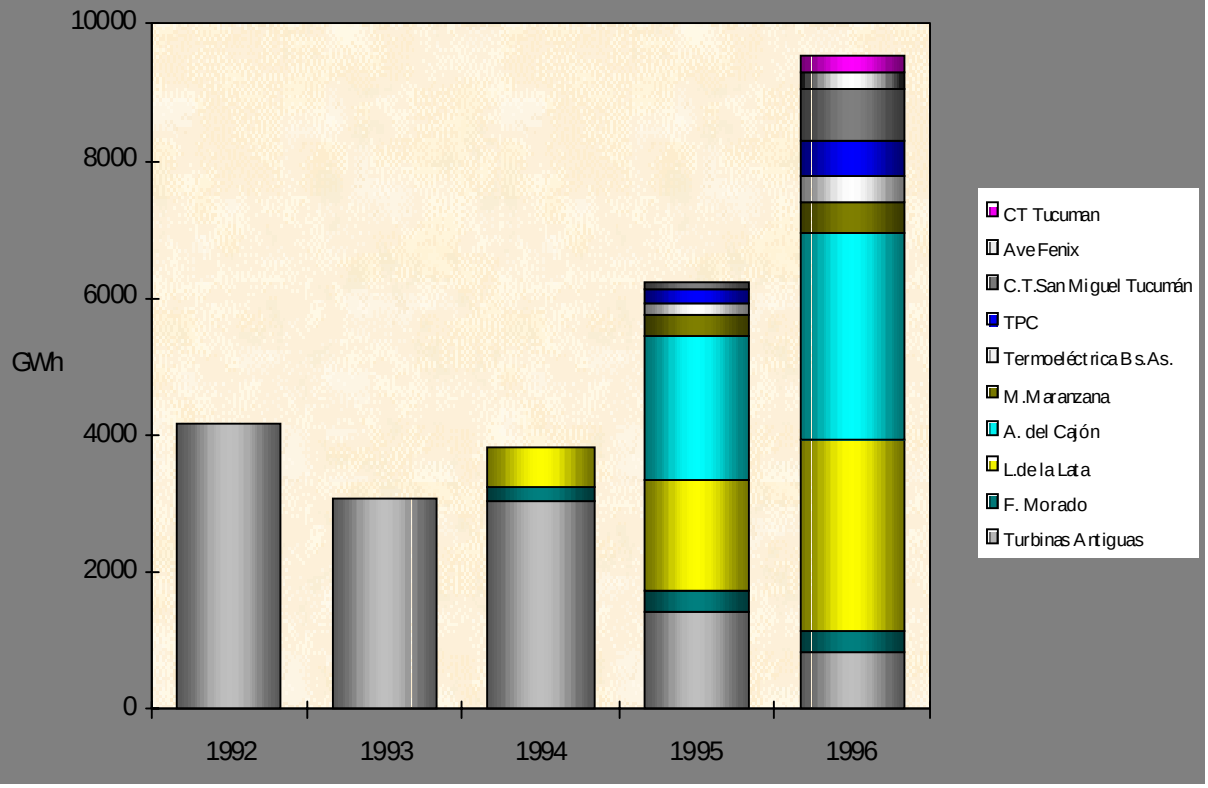


EVOLUTION OF TOTAL THERMAL GENERATION

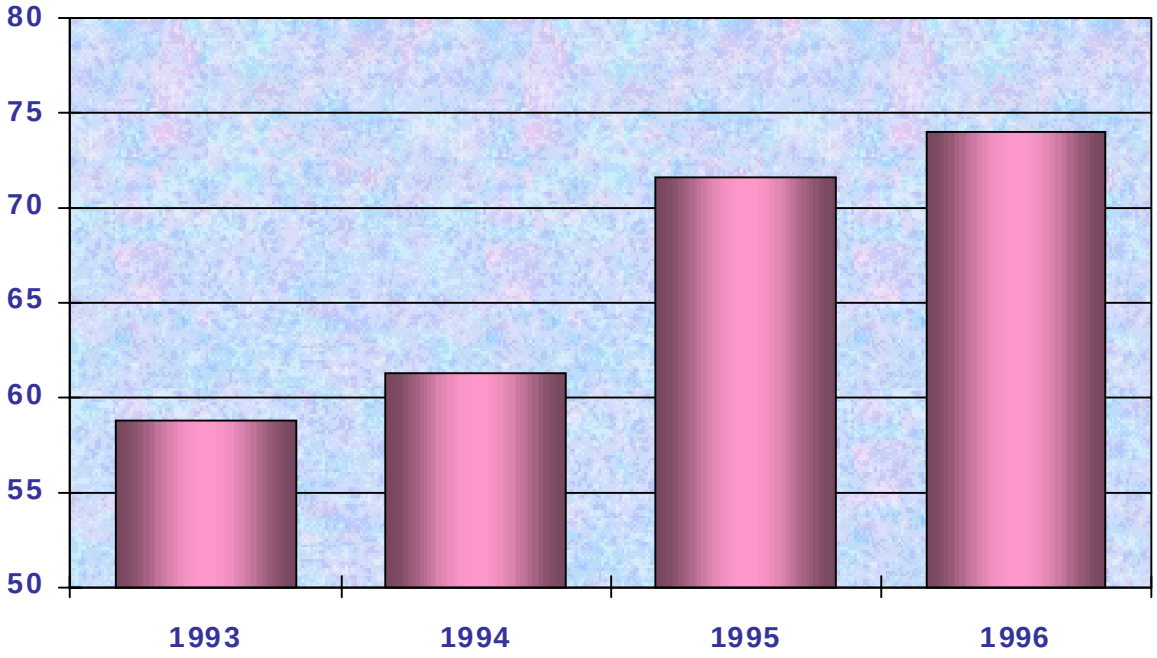


NET GENERATED ENERGY OF THE NEW GAS TURBINES

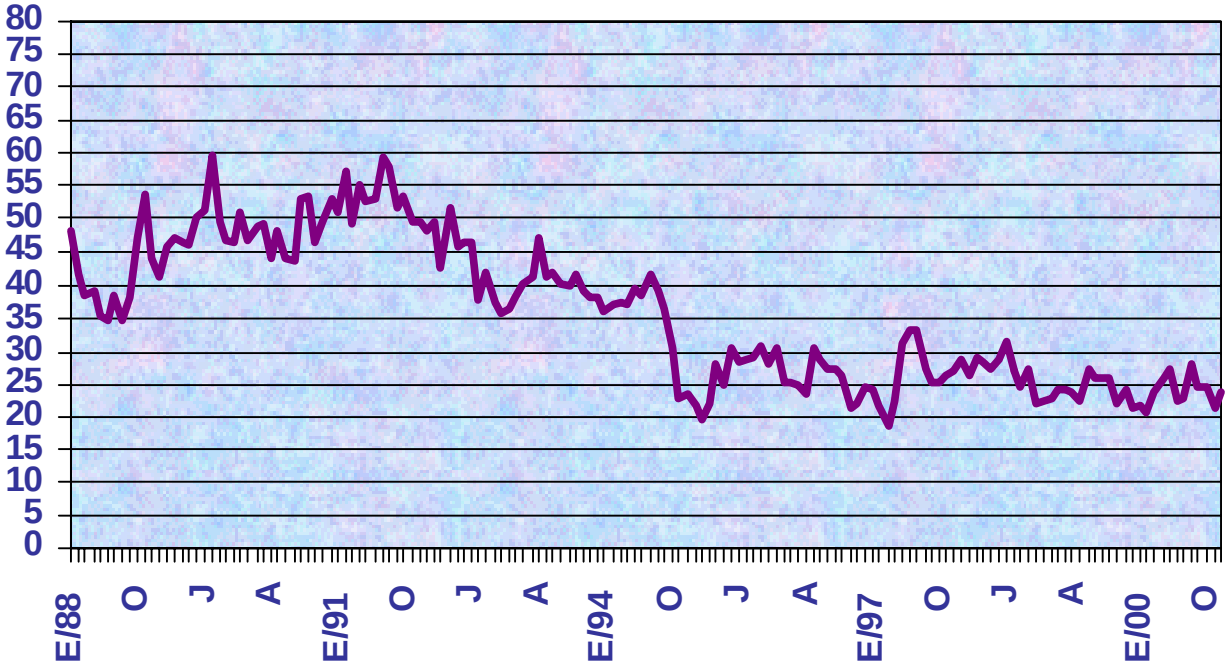
From 1992



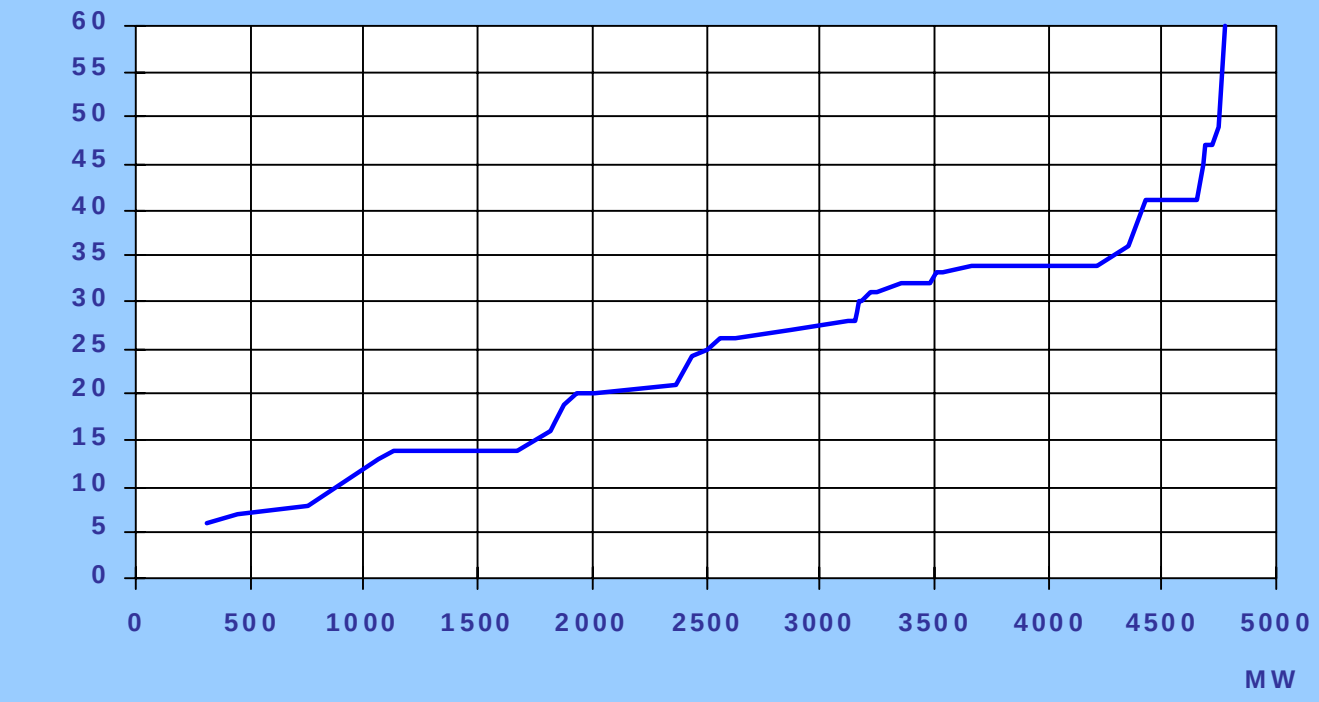
EVOLUTION OF THE THERMAL AVAILABILITY



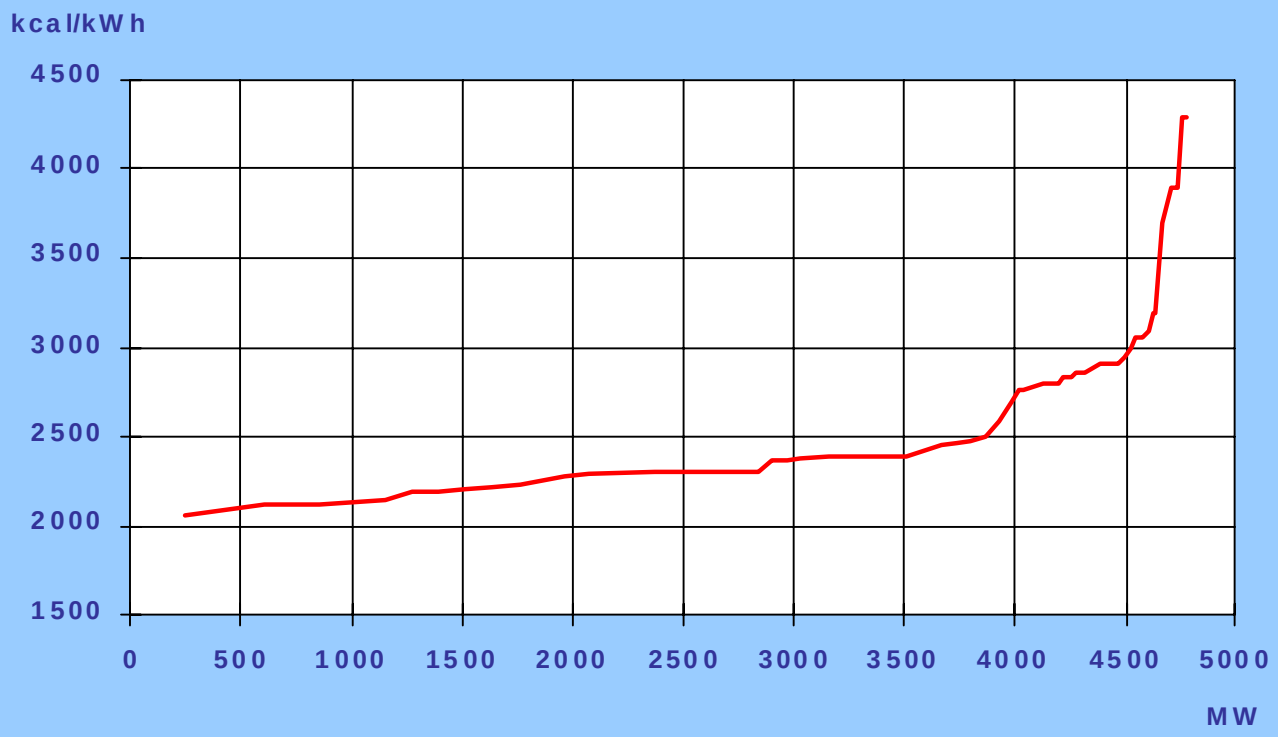
EVOLUTION OF THE THERMAL AVAILABILITY
1988-2000

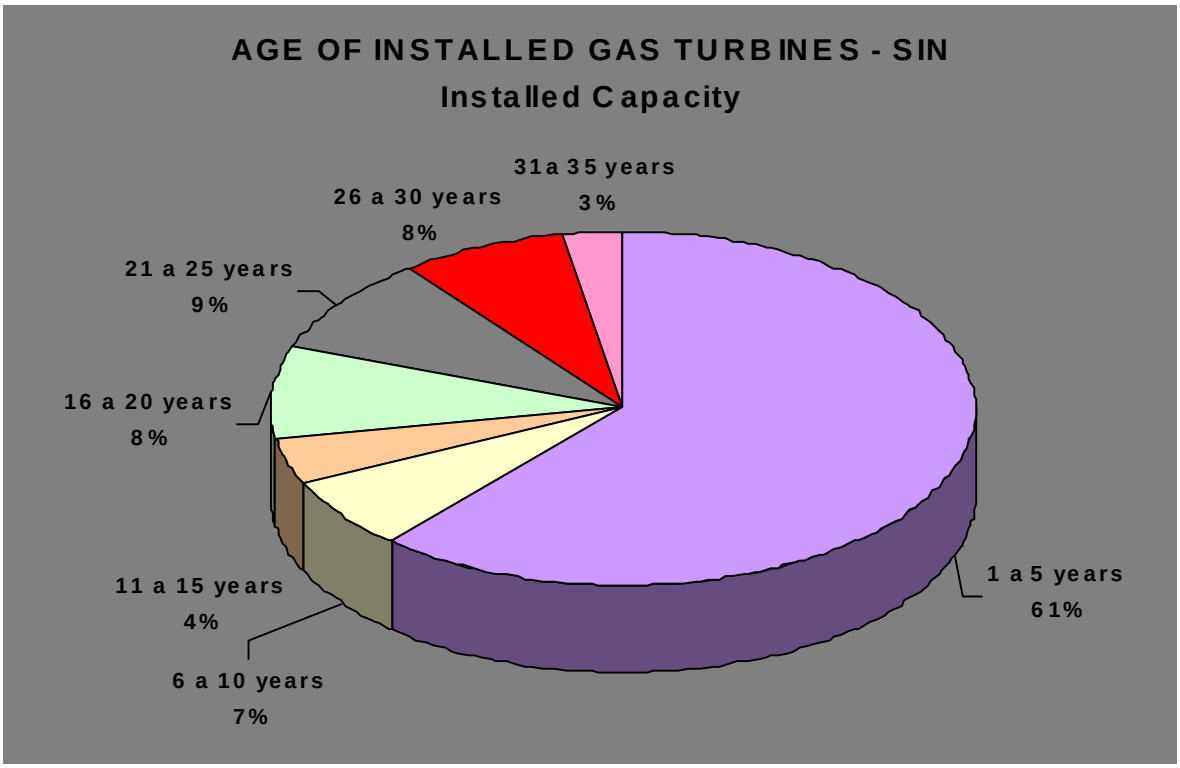


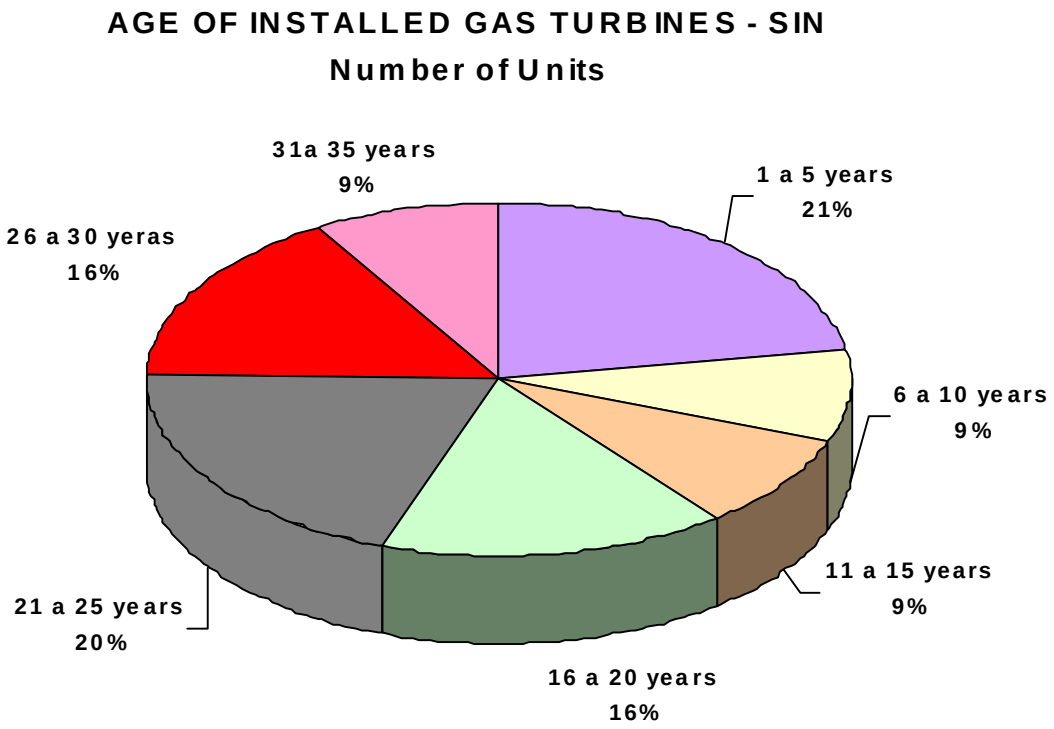
AGE OF INSTALLED STEAM TURBINES - SIN

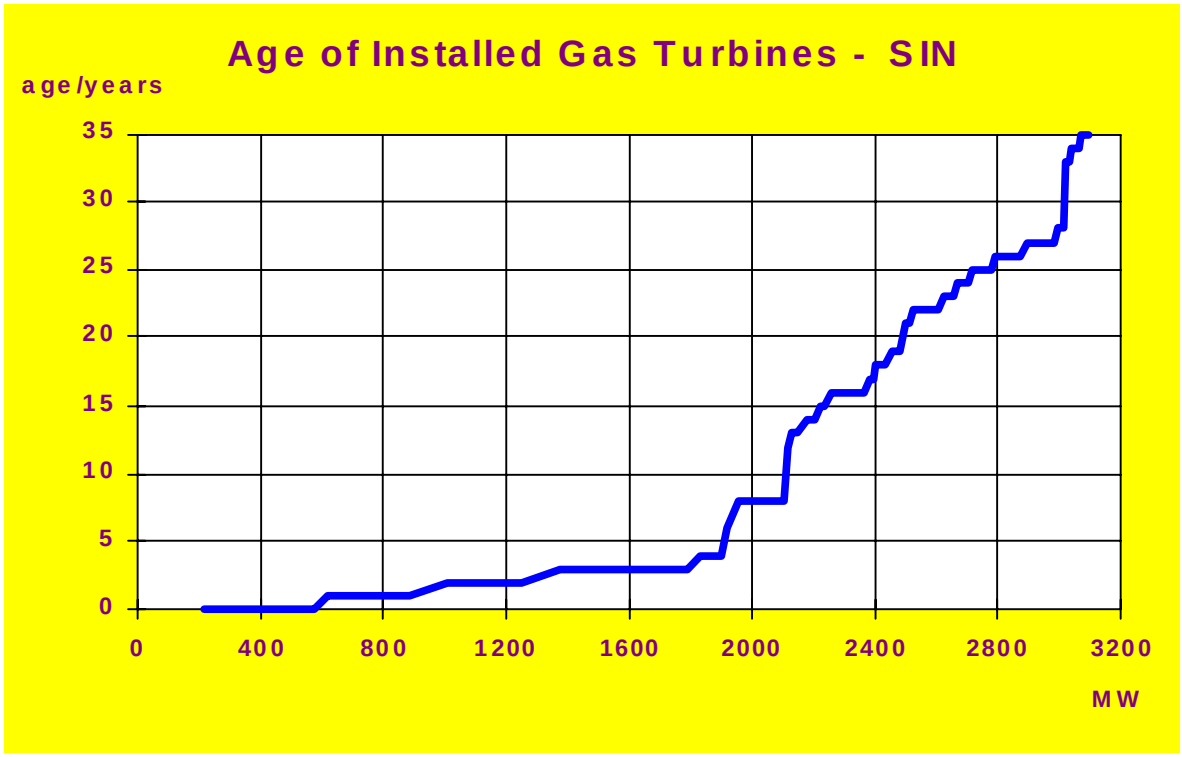


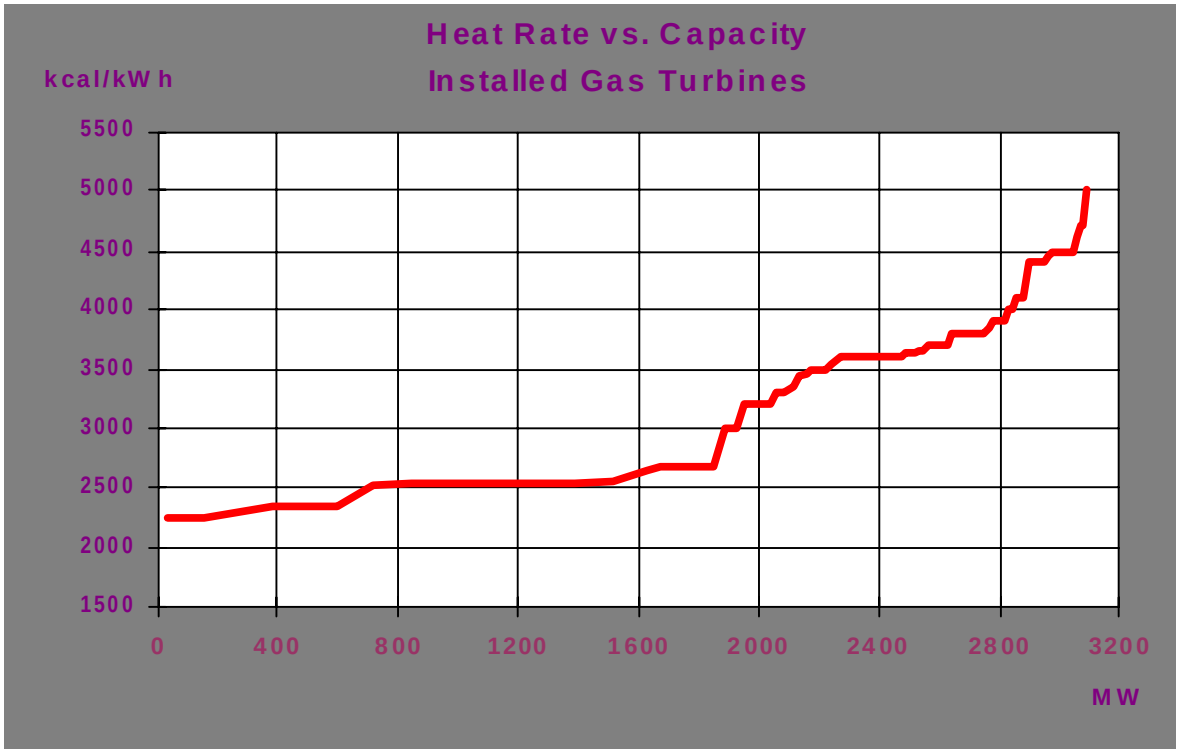
MEDIUM HEAT RATE vs. CAPACITY




AGE OF INSTALLED GAS TURBINES - SIN
Installed Capacity
31a 35 years
3%
26 a 30 years
8%
21 a 25 years
9%
16 a 20 years
8%
11 a 15 years
4%
6 a 10 years
7%
1 a 5 years
61%

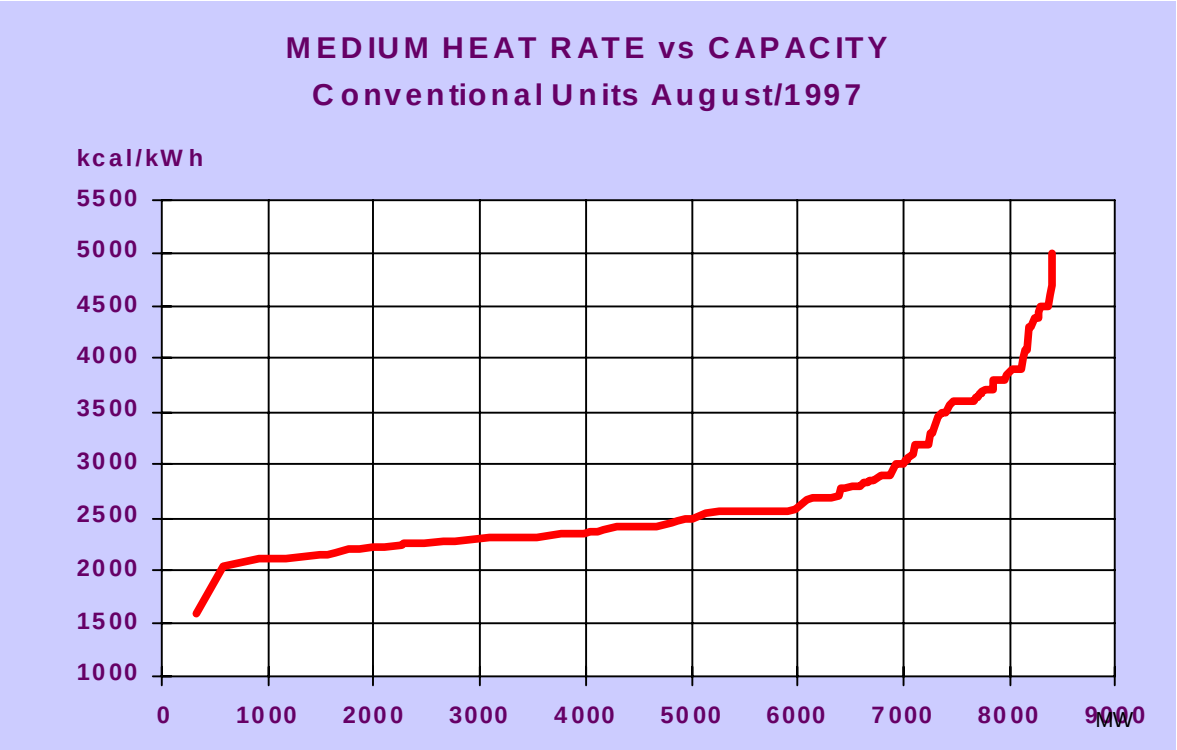

AGE OF INSTALLED GAS TURBINES - SIN
Number of Units
31a 35 years
9%
1 a 5 years
21%
26 a 30 yeras
16%
6 a 10 years
9%
11 a 15 years
9%
21 a 25 years
20%
16 a 20 years
16%

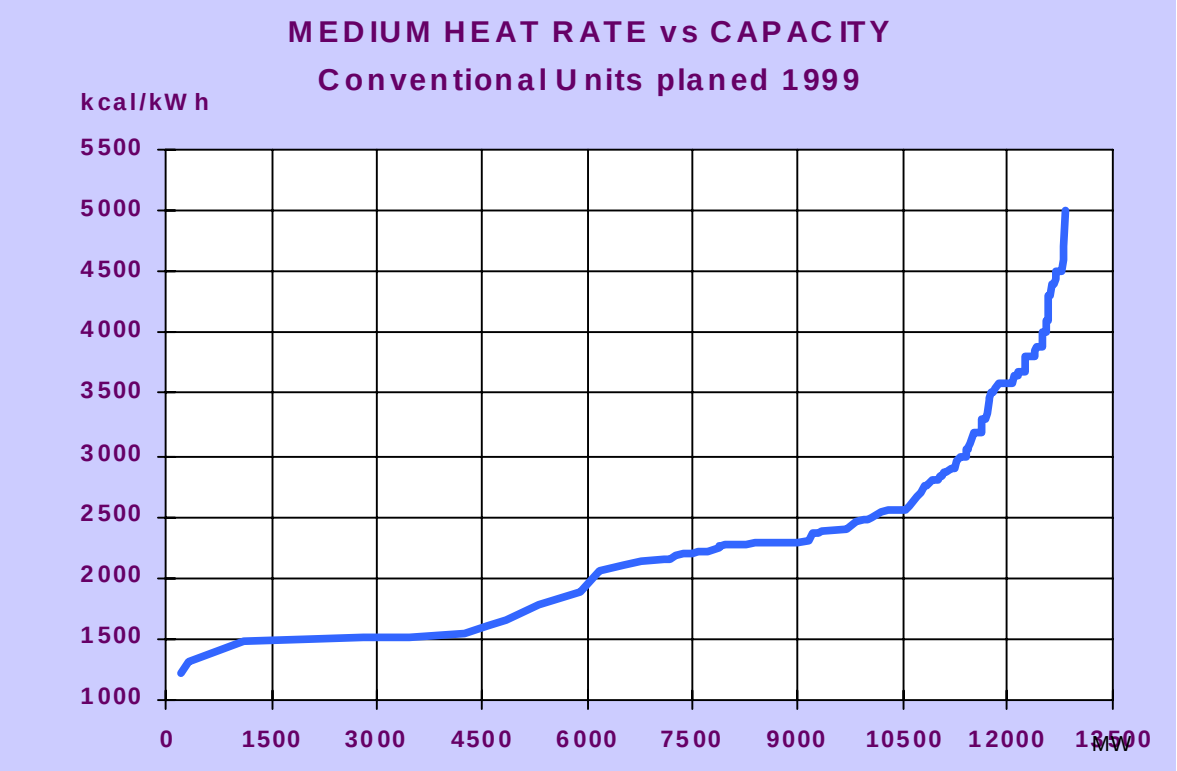

Age of Installed Gas Turbines - SIN
age/years
35
30
25
20
15
10
5
0
0
400
800
1200
1600
2000
2400
2800
3200
MW


Heat Rate vs. Capacity
Installed Gas Turbines
kcal/kW h
5500
5000
4500
4000
3500
3000
2500
2000
1500
0
400
800
1200
1600
2000
2400
2800
3200
MW

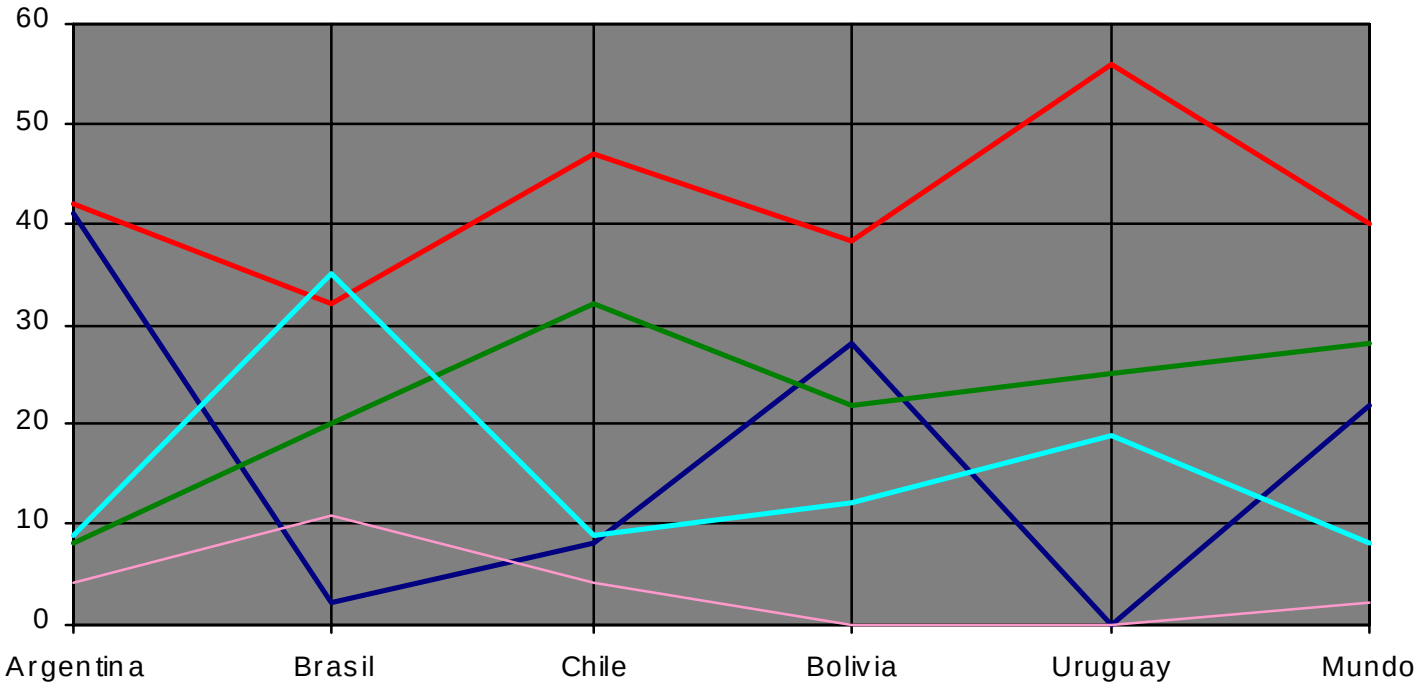
New Thermal Units

Proyecto	Capacity MW	Date of Commisioning	Acumulated Total MW
CMS Ensenada	128	1997	128
Genelba	236	1997	364
Argener	180	1997	544
Pluspetrol	150	1998	694
CT Mendoza	200	1998	894
C Costanera	851	1998	1745
C Puerto	798	1999	2543
CT Paraná	845	1999	3388
CT Agua del Cajón	270	1999	3658
C Dock Sud	780	1999	4438
Enargen	188		4626
Ceban	720		5346


MEDIUM HEAT RATE vs CAPACITY
Conventional Units August/1997
kcal/kWh
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
MW


MEDIUM HEAT RATE vs CAPACITY
Conventional Units planed 1999
kcal/kWh
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
0
1500
3000
4500
6000
7500
9000
10500
12000
13500
MW

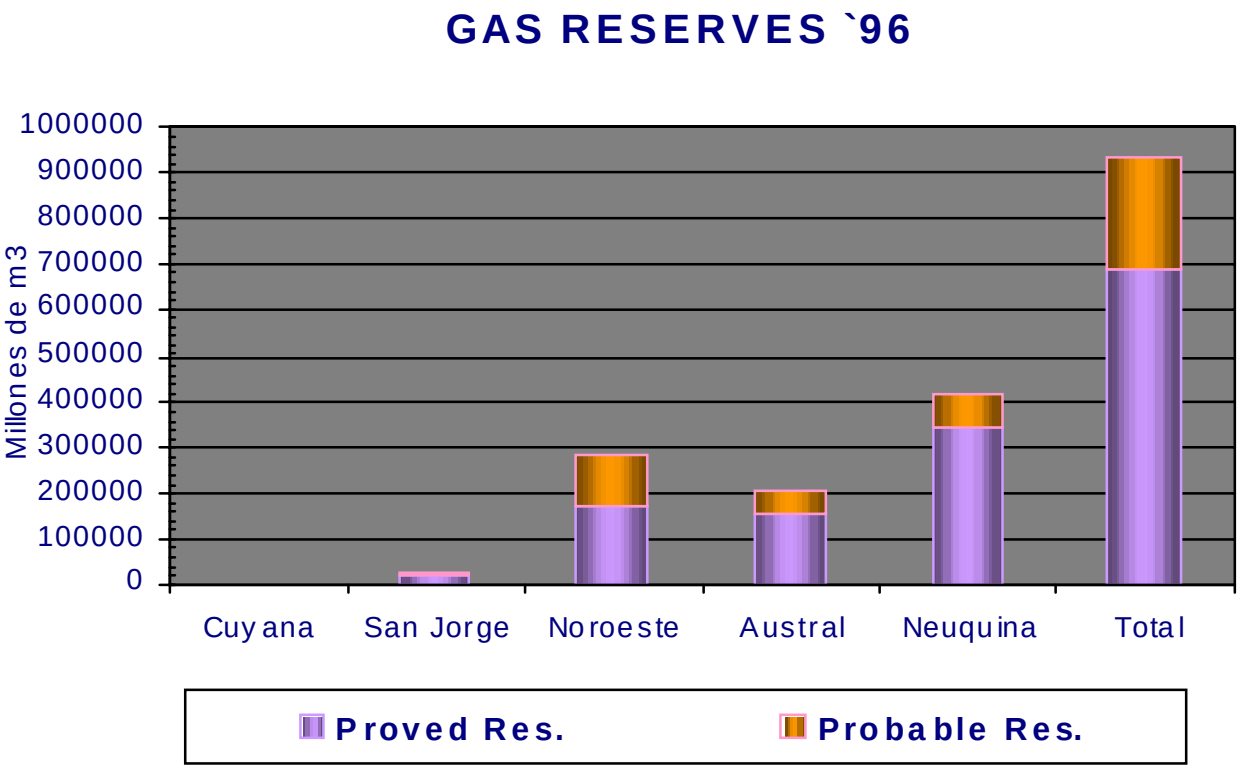
ENERGETIC MATRIX



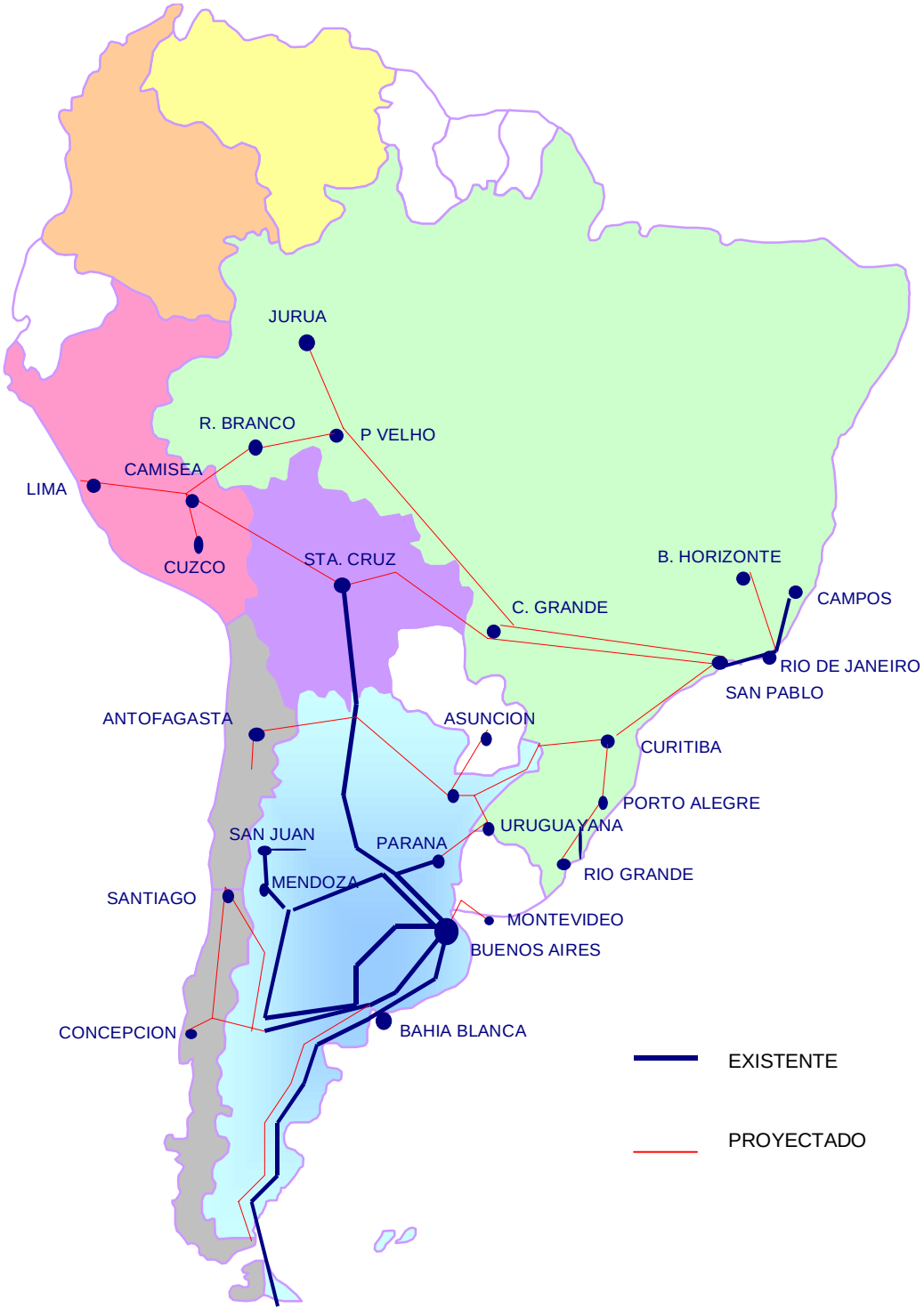
South America: PRODUCED ELECTRICAL ENERGY BY COUNTRY & BY SOURCE

	Hidro	Térmico	Nuclear	Total
Argentina	4.35	5.37	1.41	11.13
Bolivia	0.33	0.25	0	0.59
Brasil	48.22	1.20	0	49.41
Chile	3.47	0.92	0	4.39
Colombia	6.09	2.76	0	8.86
Ecuador	1.29	0.31	0	1.61
Perú	2.47	0.49	0	2.96
Paraguay	6.29	0	0	6.29
Uruguay	1.37	0.14	0	1.51
Venezuela	8.82	4.45	0	13.26
Total	82.70	15.89	1.41	100

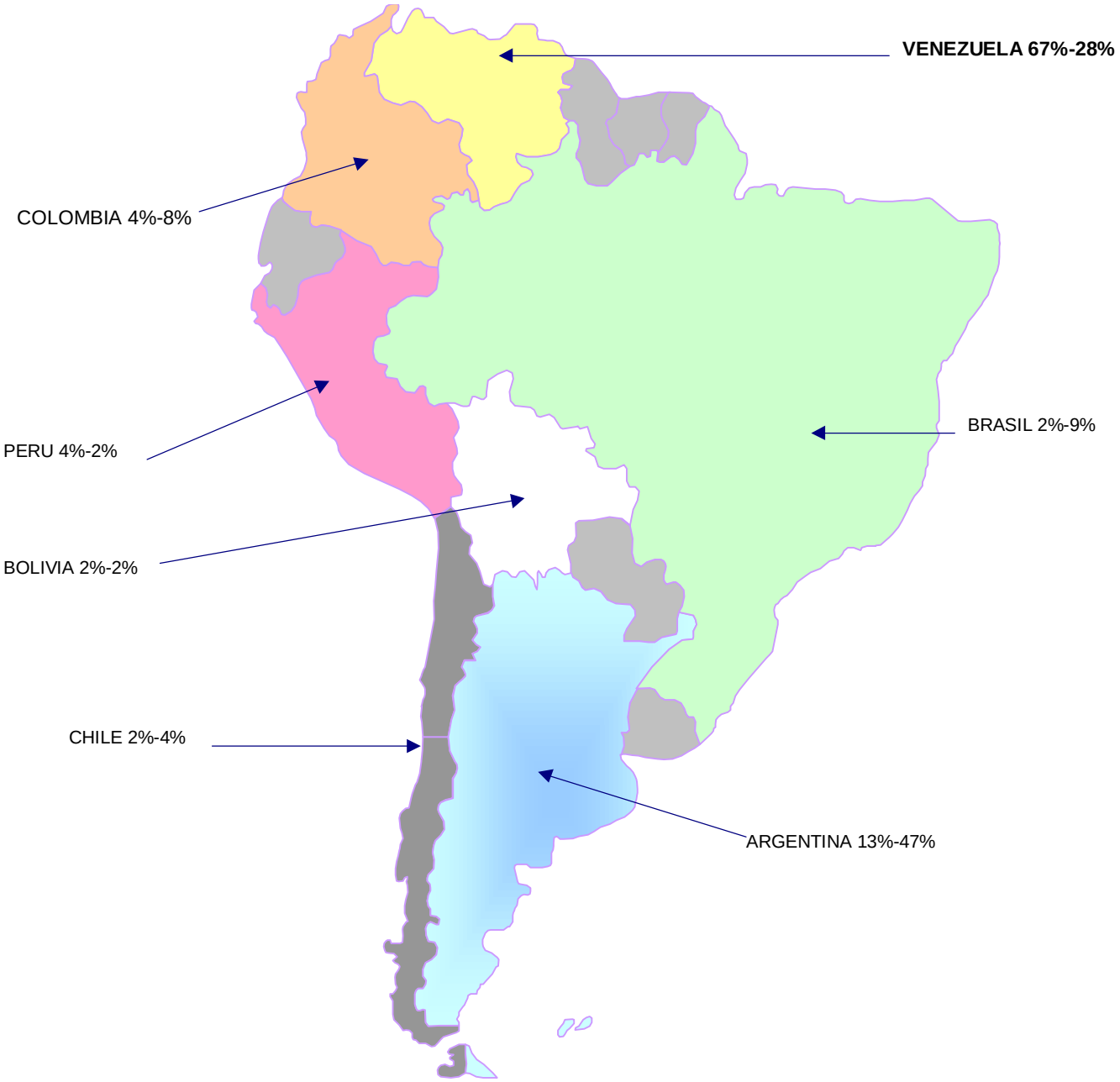
Fuente: OLADE/SIEE


GAS RESERVES `96
Millones de m3
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
Cuyana
San Jorge
Noroeste
Austral
Neuquina
Total
Proved Res.
Probable Res.

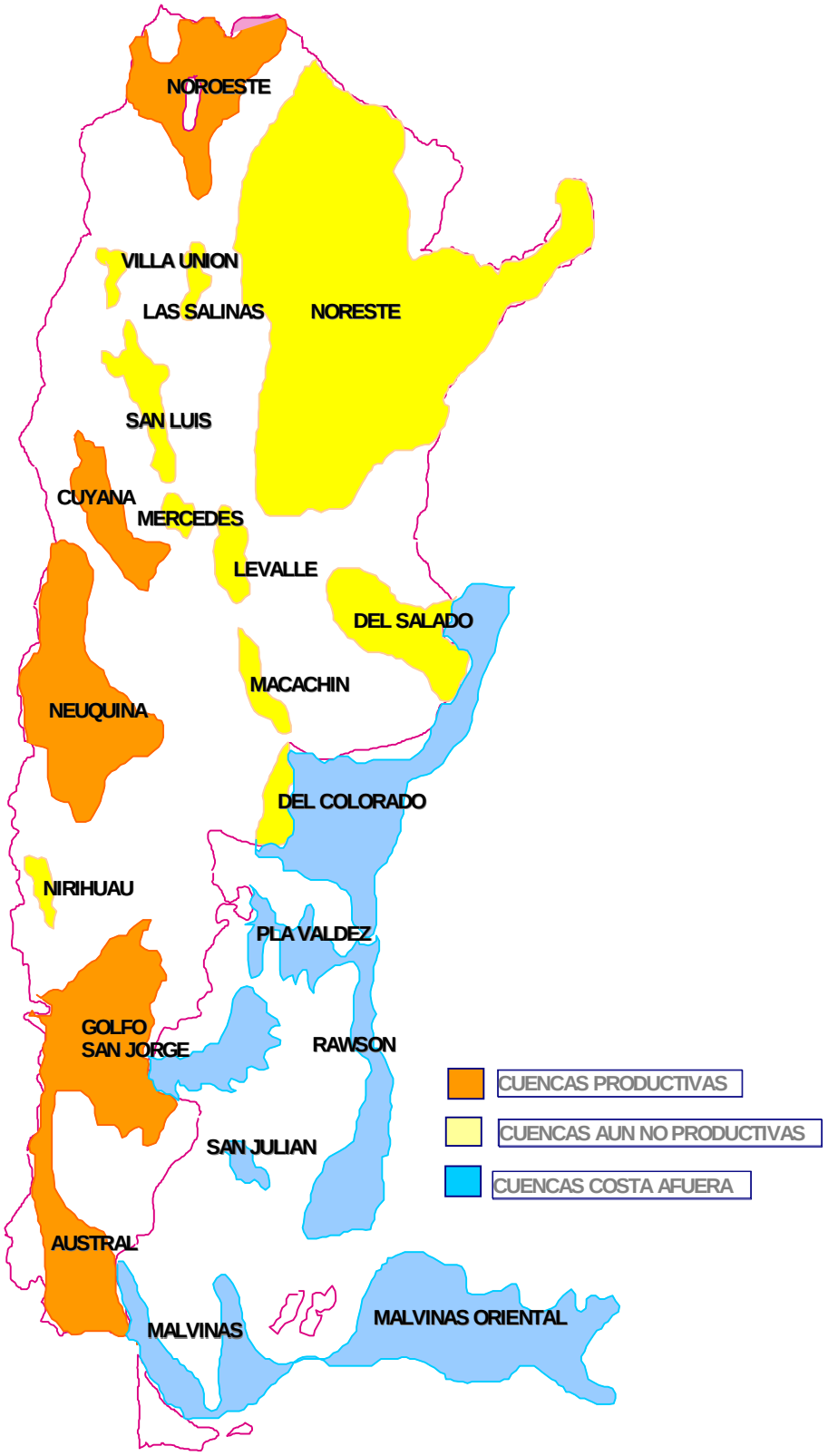
South America – EXISTING AND PROJECTED GAS PIPELINES



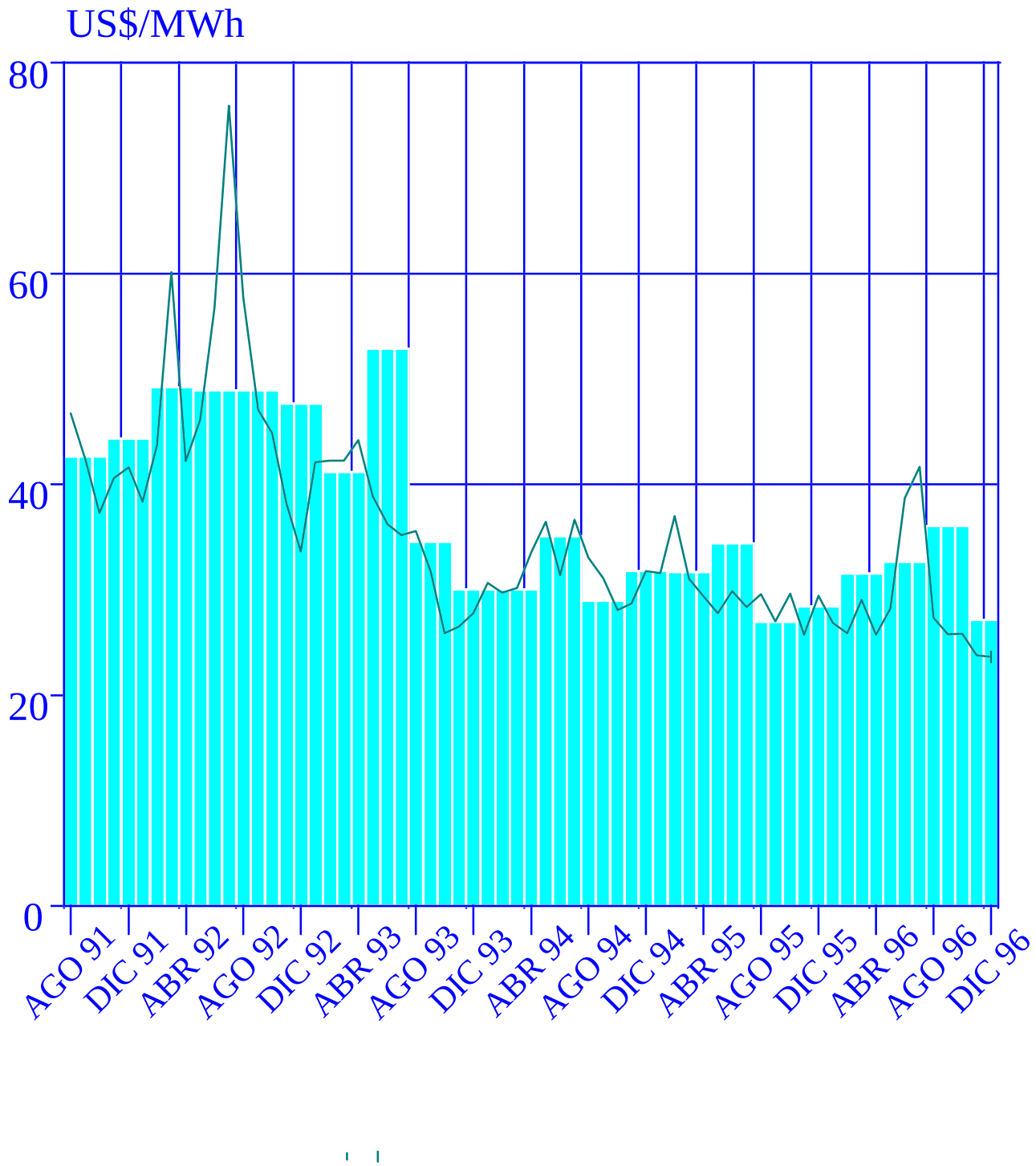
South America –RESERVES OF NATURAL GAS AND % SOLD



ARGENTINE SEDIMENTARY BASIN

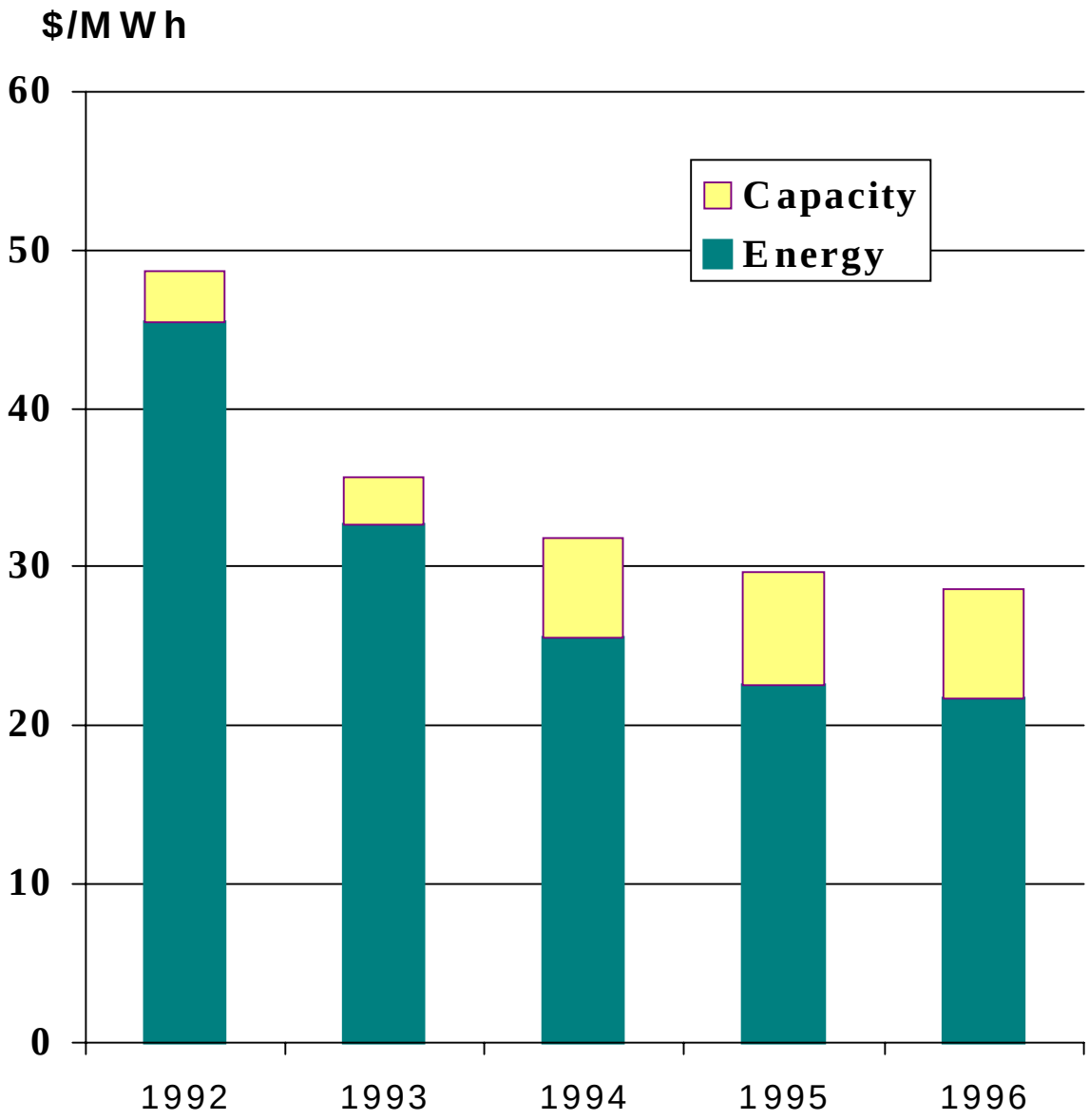


Monomical price
August 91 - December 96



CAMMESA

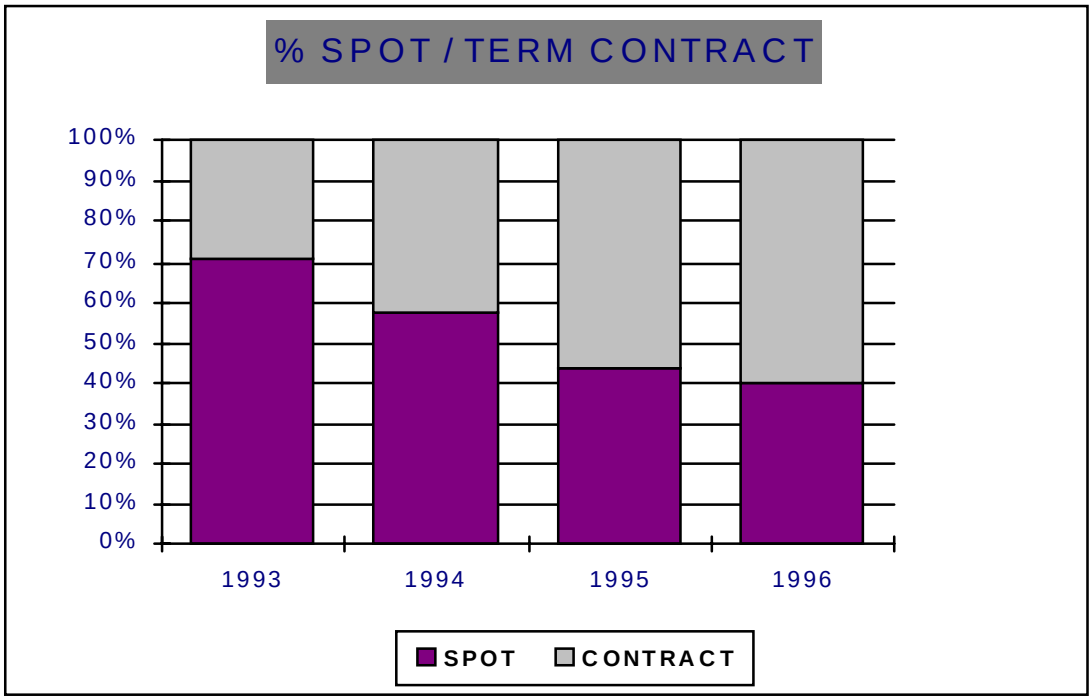
Energy price and monomical price

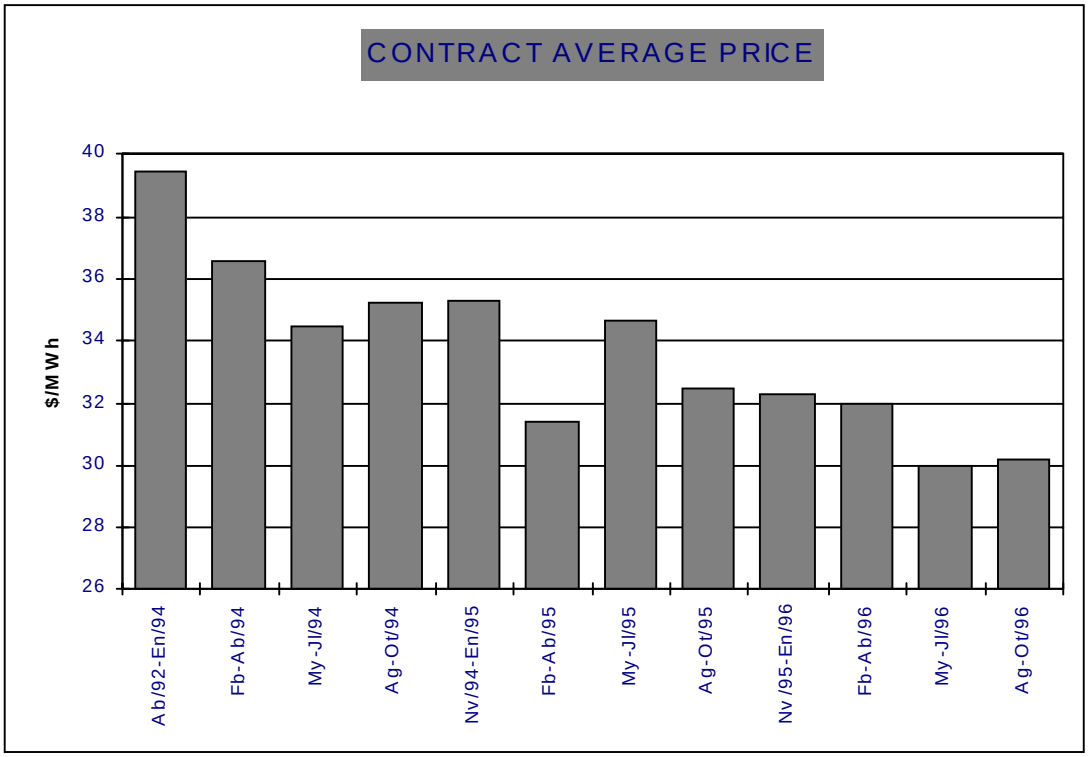


Capacity:inicial value $PPAD = 5 $/MWhfv ;
from 01/05/94 $PPAD = 10 $/MWhfv
hfv = out of valley hour

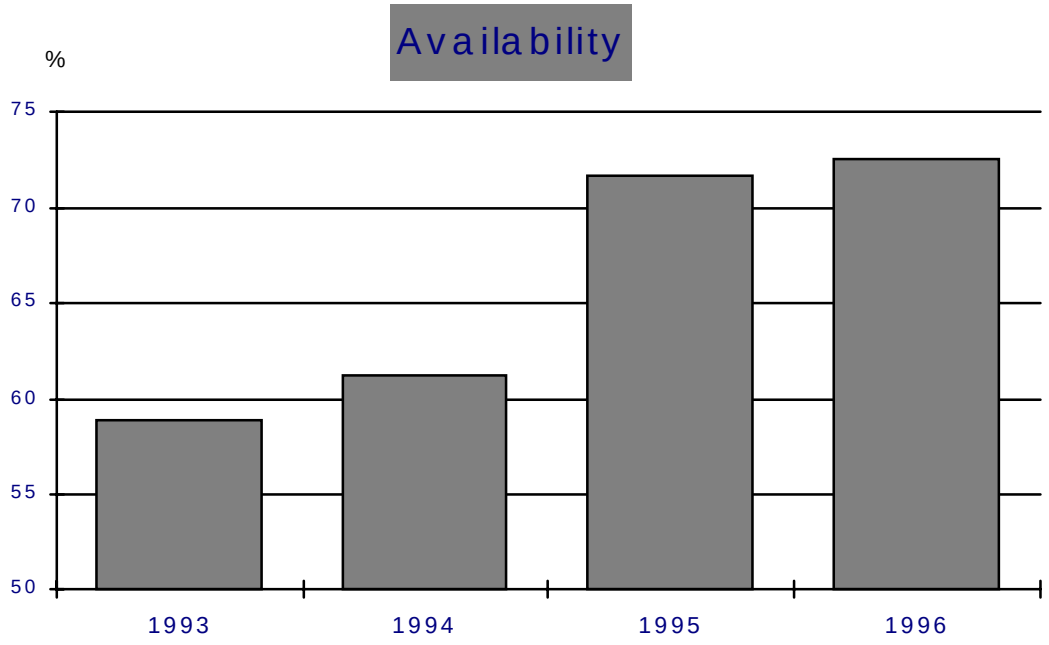
CAMMESA

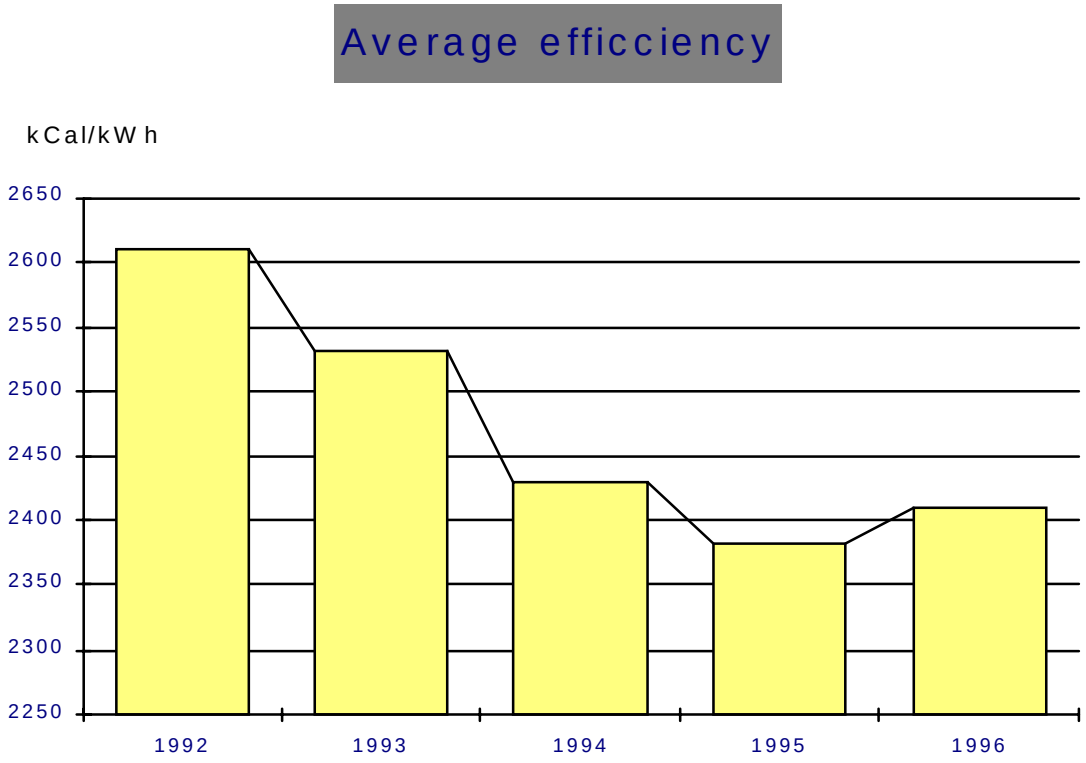
Spot and term market Price



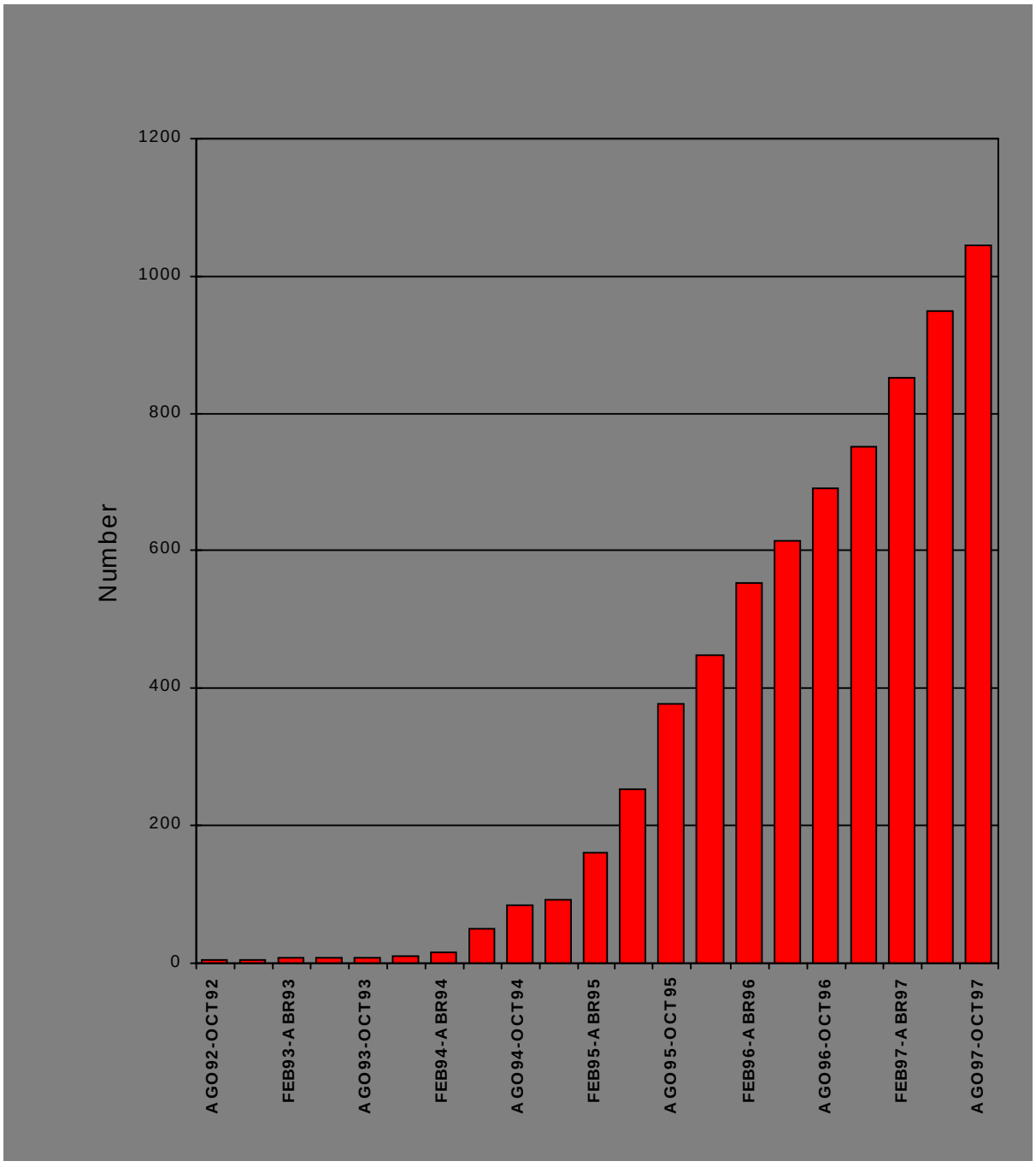


Thermal unit´s behaviour





CONTRACT NUMBER



Challenge to solve?

- Technical capacity
- Transmission system expansion with minimum time and minimum State participation

Challenge to solve?

- Quality of service, linked with transitory fault Ancillary equipment
- Load management
- Increase of free commercial trade
- long term policy associated with big users

Challenge to solve?

- Institution with fix permanent role
- Long term policy for interchange with other countries
- Firm capacity and opportunity requirement
- Long term trade
- Free access and non discriminatory policies

POWER SECTOR MAIN PRESENT AND FUTURE ACTIVITIES

- **PRIVATIZATION COMPLETION OF:**
  - **YACYRETA HYDRO.**
  - **NUCLEAR POWER STATIONS.**
  - **PROVINCIAL DISTRIBUTION COMPANIES.**
- **IMPROVEMENT OF REGIONAL ELECTRICITY SYSTEMS INTEGRATION WITH NEIGHBORING COUNTRIES.**
- **UTILIZATION OF RENEWABLE ENERGIES FOR RURAL DISPERSED POPULATION ELECTRICITY SUPPLY.**
- **PROMOTING OF EFFICIENT USE OF ENERGY TECHOLOGIES.**
- **PROMOTING ENVIRONMENTAL CONCERN.**
- **STUDY OF THE POSSIBLE IMPROVEMENT OF THE MARKET REGLAMENTATION**